Introduction to open geospatial standards

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OGC Global Advisory Council
[Open Geospatial Consortium]

20 September 2016

Glasgow, Scotland

Agenda

Part I
1. The challenges of interoperability
2. Business value of open standards

Part II
3. Technical approach for implementing standards
4. The open standards global community

Part III
5. Standards policy and industry resources
6. Participate in the standards process

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Standards are like parachutes: they work best when they're open.

Mary McRae, OASIS

What is the OGC?

Confluence of policy, technology, legal and governance issues underpinning interoperability. Open geospatial standards development and more…

OGC Standards

- Technical documents that detail interfaces or encodings;
- Software developers use these documents to build open interfaces and encodings into their products and services;
- These standards are the main "products" of the OGC and have been developed by OGC members to address specific interoperability challenges.

OGC Standards

Below is a list of OGC Implementation Standards.

Implementation Standards are different from the Abstract Specification. They are written for a more technical audience and detail the interface structure between software components. An interface specification is considered to be at the implementation level of detail if, when implemented by two different software engineers in ignorance of each other, the resulting components plug and play with each other at that interface.
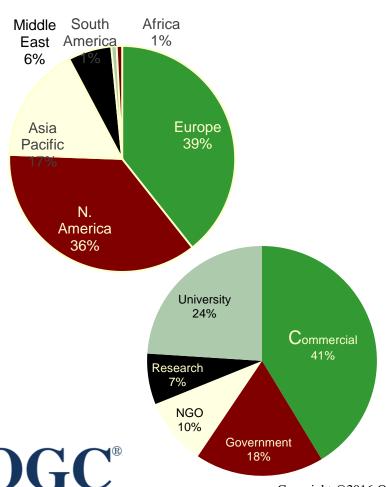
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The Open Geospatial Consortium

Not-for-profit, international voluntary consensus standards organisation leading development of open geospatial standards

Regional membership pie chart:
- Middle East 6%
- South America 1%
- Africa 1%
- Europe 39%
- Asia Pacific 17%
- N. America 36%

Sector membership pie chart:
- University 24%
- Research 7%
- NGO 10%
- Government 18%
- Commercial 41%

Founded in 1994

500+ industry, government, academic, research and NGO members worldwide

Social and technical forum to align interests in standards and best practices

40+ freely available standards

Thousands of product implementations

Broad user community worldwide

Alliances and collaborative activities with many SDOs and professional associations

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Example Commercial Members

pitney bowes

DigitalGlobe

Google

esri

ORACLE

LOCKHEED MARTIN

INTERGRAPH

AIRBUS
DEFENCE & SPACE

BENTLEY

wikitude

BAE SYSTEMS

agi
Analysis software for land, sea, air, & space

VENCORE

THALES

Spacemetric

ENVITIA
World Class Spatial Information Technologies

AUTODESK

Trimble

NAVTEQ

PCI
Geomatics

CAE

Microsoft

1Spatial

LUCIAD

ROLTA

Raytheon

galdos
systems inc

Skyline

Snowflake
software

exactEarth

Leica
Geosystems

HARRIS

CubeWerx
Interoperable Services for the Geo-Spatial Web

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Insurance Evolved FM Global

LIZARDTECH
a celartem Company

Example global standard: KML

"What OGC brings to the table is...everyone has **confidence** we won't take advantage of the format or change it in a way that will harm anyone... Governments like to say they can publish to **OGC KML** instead of Google KML "

Michael Weiss-Malik,
Google KML product manager

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Google

Example Government Members

- DSTL (UK)   - DLR (Germany)   - DIGO (Australia)   - NGA (USA)

- NOAA (USA) - NASA (USA)   - USGS (USA)   - USACE / AGC

- DISA (US)   - DGIWG (NATO)   - EUSC (Europe)   - USAF Weather Agency

- NR Canada   - DHS (US)   - BRGM (France)   - United Nations

- European Satellite Centre   - Naval MET and Oceanography Command

- Abu Dhabi Systems & Information Centre (ADSIC)   - Ordnance Survey (GB)

- Geonovum (Netherlands)   - Land Information New Zealand

- Norwegian Building Authority   - Dubai Municipality (UAE)

- Dept Science & Tech. (India)   - European Space Agency

- National Centre for Statistics and Information (Oman)

- Ministry of Land, Infrastructure and Transport (Korea)

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Part I

1. **The challenges of interoperability**
2. **Business value of open standards**

Standards and interoperability

Challenges of Interoperability

- Light bulbs seamlessly fit into sockets;
- Money can be withdrawn from any ATM anywhere;
- Mobile phones just work around the world;
- Latitude and Longitude provide a standa reference system for the Earth.

http://en.wikipedia.org/wiki/LED_lamp

Challenges of Interoperability

"We can't share maps on the Web."

"We can't deliver data to different systems."

"We don't have a common language to speak about our geospatial data or our services."

"We can't find and pull together data from our automated sensors."

"We have security issues relating to geospatial data exchange."

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Challenges of Interoperability

Across multiple domains

Use cases

current aviation

future aviation

wildfire

severe weather warning service

sustained polar science campaign

climate assessment

landfalling hurricane

plume forecasting for emergency response

winter highways maintenance

riverine flood forecasting

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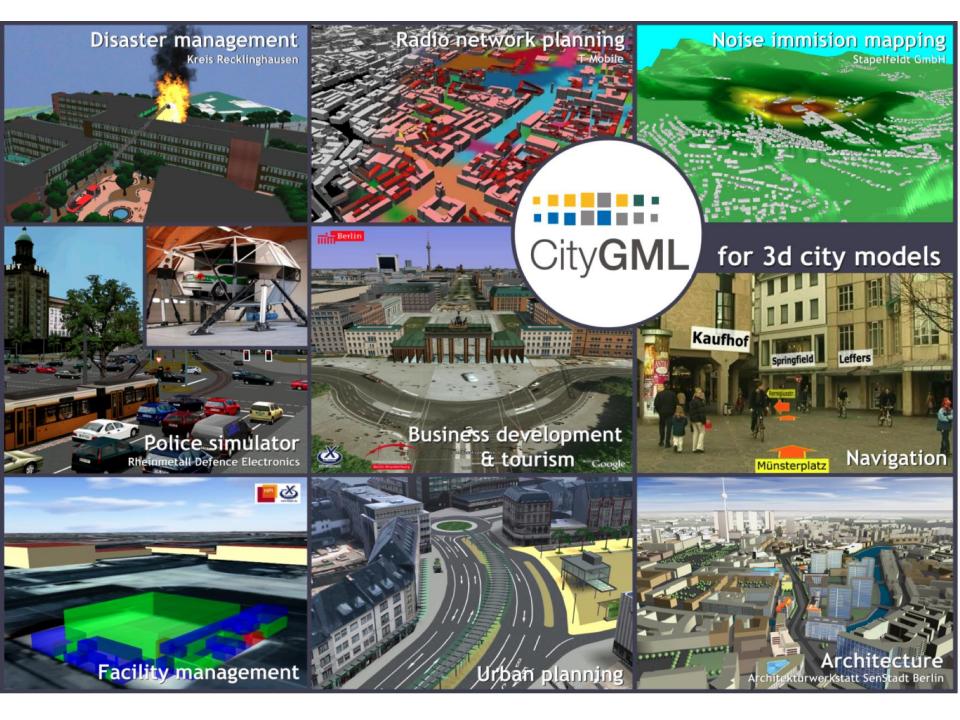
Towards Intelligent Cities

- **Urban Planning / Operations**
- **Emergency Mgt / Response**
- **Transportation / Routing / Logistics**
- **Retail Site analysis**
- **Sustainable / Green Communities**
- **City Services Management**
- **Noise abatement**
- **Telecommunications placement**
- **Tourism**
- **Many other uses…**

Disaster management
Kreis Recklinghausen

Radio network planning
T-Mobile

Noise immision mapping
Stapelfeldt GmbH

Police simulator
Rheinmetall Defence Electronics

Business development
& tourism

Navigation

Kaufhof
Springfield
Leffers
Remigiusstr.
Münsterplatz

CityGML for 3d city models

Facility management

Urban planning

Architecture
Architekturwerkstatt SenStadt Berlin

OGC CityGML adoption

- Europe
  - INSPIRE (Infrastructure for Spatial Information in Europe)

- The Netherlands National 3D standard
  - CityGML part of Dutch 3D Standard

- CityGML based urban Models:
  - Abu Dhabi and Kingdom of Bahrain in Middle East
  - Berlin, Vienna, Paris & Geneva in Europe
  - Singapore in Asia

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Observation and Measurement
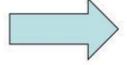
Integrated Ocean Observing System

A National Endeavor

INTEGRATED OCEAN OBSERVING SYSTEM

But Part of a Global Framework

Global Ocean Observing System

THE GLOBAL EARTH OBSERVATION
SYSTEM OF SYSTEMS

INFORMATION
FOR THE BENEFIT
OF SOCIETY

Global Earth Observation System of Systems

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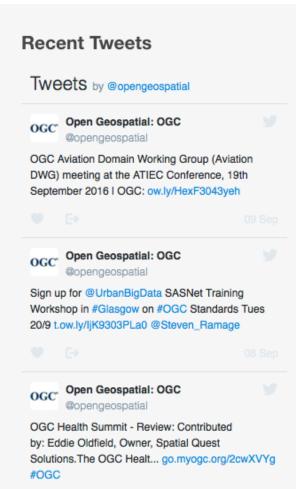
Welcome to the OGC

The OGC (Open Geospatial Consortium) is an international not for profit organization committed to making quality open standards for the global geospatial community. These standards are made through a consensus process and are freely available for anyone to use to improve sharing of the world's geospatial data.

OGC standards are used in a wide variety of domains including Environment, Defense, Health, Agriculture, Meteorology, Sustainable Development and many more.

Our members come from government, commercial organizations, NGOs, academic and research organizations.

Consider becoming a member today and join our dynamic and diverse global standards community.

Recent Tweets

Tweets by @opengeospatial

Open Geospatial: OGC
@opengeospatial

OGC Aviation Domain Working Group (Aviation DWG) meeting at the ATIEC Conference, 19th September 2016 I OGC: ow.ly/HexF3043yeh

09 Sep

Open Geospatial: OGC
@opengeospatial

Sign up for @UrbanBigData SASNet Training Workshop in #Glasgow on #OGC Standards Tues 20/9 t.ow.ly/IjK9303PLa0 @Steven_Ramage

08 Sep

Open Geospatial: OGC
@opengeospatial

OGC Health Summit - Review: Contributed by: Eddie Oldfield, Owner, Spatial Quest Solutions.The OGC Healt... go.myogc.org/2cwXVYg #OGC

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http://www.opengeospatial.org

Domain Working Groups

Name	Lead **
3DIM DWG (3DIM DWG)	Carsten Roensdorf, Ordnance Survey
Agriculture DWG (Agriculture DWG)	Joshua Lieberman, Harvard University
Architecture DWG (Arch DWG)	Carl Reed III, Reed, Carl
Aviation DWG (Aviation DWG)	Hubert Lepori, Eurocontrol
Big Data DWG (BigData DWG)	Peter Baumann, Jacobs University Bremen GmbH
Catalog DWG (Cat DWG)	Uwe Voges, con terra GmbH
Coordinate Reference System DWG (CRS DWG)	Keith Ryden, Esri
Coverages DWG (Coverages DWG)	Peter Baumann, Jacobs University Bremen GmbH
Data Preservation DWG (PreservDWG)	Steve Morris, North Carolina State University
Data Quality DWG (DQ DWG)	Matt Beare, Beare, Matthew
Defense and Intelligence DWG (D and I DWG)	Lucio Colaiacomo, European Union Satellite Centre
Earth Systems Science DWG (ESS WG)	Stefano Nativi, CNR Institute for Atmospheric Pollution Research
Emergency & Disaster Management DWG (EDM DWG)	Jacqueline (Jaci) Knudson, US Dept. of Defense/DISA
Energy and Utilities DWG (EnergyUtilities)	Renee Bogle Hughes, Hughes, Renee Bogle
Geography Markup Language (GML) DWG (GML DWG)	Ron Lake, Galdos Systems Inc.
Geosemantics DWG (Semantics)	Joshua Lieberman, Harvard University
Health DWG (Health DWG)	Eddie Oldfield, Oldfield, Eddie
Hydrology DWG (Hydrology DWG)	Tony Boston, Australian Bureau of Meteorology

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Knowledge interoperability

Human to Human

SEMANTIC

SYNTACTIC

Know

Machine to Machine

Learn

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Shared understanding

A Vertical Obstruction

An Observation Post

A Navigation Beacon

What is this?
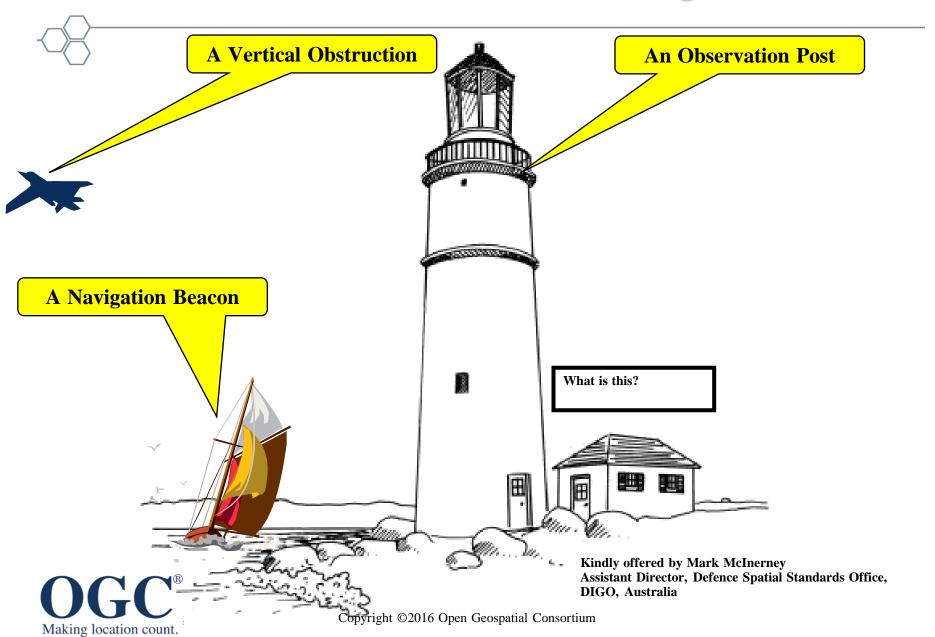
Kindly offered by Mark McInerney
Assistant Director, Defence Spatial Standards Office,
DIGO, Australia

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So
what?

Cross-domain use case

- UC11: Riverine Flood Forecasting using Meteorological Ensemble Forecasts;

- People mainly interested in the impact of weather;

- How do we integrate weather and climate information into the hydrology domain?

- Cross-domain engagement with OGC Met Ocean and Hydrology Domain Working Groups (as well as Emergency & Disaster Management)

Slide courtesy of Jeremy Tandy, UK Met Office

riverine flood forecasting

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Part I

1. ~~The challenges of interoperability~~
2. Business value of open standards

Business value of open standards

Business Value Committee

The OGC Business Value Committee (BVC) will directly engage senior managers, commercial, sales and marketing professionals from the OGC membership in activities to identify, organize and promote the business value of OGC standards. These activities include a long-term vision to develop (through case studies and reference implementations) a pervasive value platform for using OGC and complementary standards; as well as defining a business model to address a Standards Value Model, incorporating both costs and benefits. The BVC will also provide a website in which OGC members may quickly and easily find business value data for use in their own domains and presentations.

The **mission** of the BVC is to

1) Assess the effort (costs) and outcomes (benefits) required to successfully use geospatial standards
2) Understand and articulate the advantages of developing and using OGC standards
3) Enable the wider community of stakeholders to leverage business value as a tool to foster investment and implementation

The BVC will assess the return on investment requirements in line with the value of geospatial standards and highlight how using OGC® standards can offer value across the community in a cost-effective and sustainable manner.

The Business Value Committee email list is open to both members and non-members. Subscribe to the list here.

Interoperability: information sharing

Breaking down barriers between:
- Nations, languages and cultures
- Disciplines, professions and industries
- Industry, government, academia and the public
- Local, regional and national government
- Teams, departments, organisations
- Different technologies and vendor products
- Legacy systems and new components/solutions

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Interoperability: information value

Help policy and decision makers
to address the following:

a) Is the activity for public benefit?
   Measure and record value or ROI

b) What is the business driver?
   Internal efficiency, customer satisfaction

c) Does a capability already exist?
   Enable reuse, avoid duplication

Value must be measured

Standards ROI

Multiple studies confirm the value and advantages of open, standards-based solutions:

– NASA Geospatial Interoperability: Return on Investment Study:
  http://gio.gsfc.nasa.gov/docs/ROI%20Study.pdf

– Value of Standards, Delphi Report:
  http://www.delphigroup.com/research/whitepapers/20030728-standards.pdf

– Economic Benefits of Standardization, DIN German Institute for Standardization:
  http://www.sis.se/upload/632248898159687500.pdf

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Five value factors – NASA study

- Direct user (or customer) value
- Social (or non-direct, public) value
- Government foundation/operational value
- Government financial value
- Strategic/political value

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Direct user value

- Data availability
- Ease of use
- Broad data sharing capabilities

Social value

- Better decision making ability
- Extra-governmental coordination
- Minimal barriers
- Institutional effectiveness
- Efficient use of taxpayer resources

Government operational value

- Ease of integration
- Intragovernmental collaboration
- Public participation/accountability
- Interagency collaboration
- Reuse, adaptation and consolidation
- Mainstreaming of GIS
- IT Performance

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Government financial value

- Total Cost Savings
- Total Cost Avoidance

Strategic/political value

- Supports Improved Working Relationship
- Decision Making
- Supports Spatial Data Infrastructure
- E-Gov Support

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For every $100 million spent on projects based on proprietary platforms, **the same value could have been achieved with $75 million** if the projects had been based on open standards.

NASA study overall results

Kylie Armstrong , CRC-SI and Landgate –

" When you are delivering spatial web services on behalf of 20 government agencies to more than a 1000 organisations running their own spatial systems, you need standards.

Using the internationally recognised OGC and ISO standards for both the architecture and web services has been essential to our success."

Technology providers and researchers

Early insight into user interoperability needs and early experience/contribution to developing standards

Bring new products and services using OGC specifications into the marketplace earlier

Reduce development costs/risks and lead time for developing interfaces (community wide cost sharing)

Broaden market reach via products that implement OGC specifications; global activity

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End users and advisers

Avoid duplication, solve problems and exchange knowledge and know-how

Technology risk reduction – encourage market to develop and validate open interfaces

Improve choice and competition in the marketplace – procure your choice of standards-based products

Reduce technology life cycle costs – standards-based COTS, help reduce custom solutions and associated maintenance costs.

Rapidly insert new technology – speed up transfer of new solutions into use.

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EEA – why members

- Transparency is a high value in OGC
- Get involved as deep as you like
- EEA is member of OGC since July 2007
- Voting rights on standards in OGC
- Try to understand the processes
- Define our own role in OGC processes
- **Being aware of upcoming standards and actual development processes (instead of waiting for specs)**
- **Get in dialogue with industry (knowledge & knowhow)**
- ...

**Input courtesy of
Franz Daffner, EEA**

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EEA – why members

- OGC standards have been built out broadly in the international marketplace
- Adopted OGC standards as well as those in development are extremely relevant to EEA, its partners, and the broader international Environmental community
- Active involvement in OGC committees, working groups, testbeds, pilots and experiments will help prioritize standards needs and accelerate standards adoption
- **Inclusion of OGC and complementary ISO standards in procurement policy will accelerate industry delivery of interoperable solutions.**

**Input courtesy of
Franz Daffner, EEA**

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EEA – standards at all levels

Geoportal frameworks	Applications	EU Geoportal
WMS, WFS, WCS, KML, WPS	Communication (protocols)	Network services
WG data quality		Quality and validity
SWE	Security / Transport	Use restrictions
NetCDF binary format for meteorological data	Data formats text/binary	Data exchange
Archive systems	Storage	Data specification
WG on taxonomy, semantic mapping	Content interoperability	34 themes
	Any data	

Regional SDI – Catalunya, Spain

IDEC is a shared initiative of the Cartographic Institute of Catalonia (ICC), the Department of Territorial Policy and Public Works, the Secretariat for Telecommunications and Information Society, and the Department of Universities, Research and Information Society of the Generalitat de Catalunya.

To evaluate the SDI benefits, the SDI Unit of the JRC commissioned a socio-economic impact study of the SDI in Catalunya. The Centre of Land Policy and Valuations of the Universitat Politècnica de Catalunya ran a one-year study using indicators to measure:
- the efficiency
- effectiveness, and
- wider socioeconomic benefits of an SDI.

Regional SDI – Catalunya, Spain
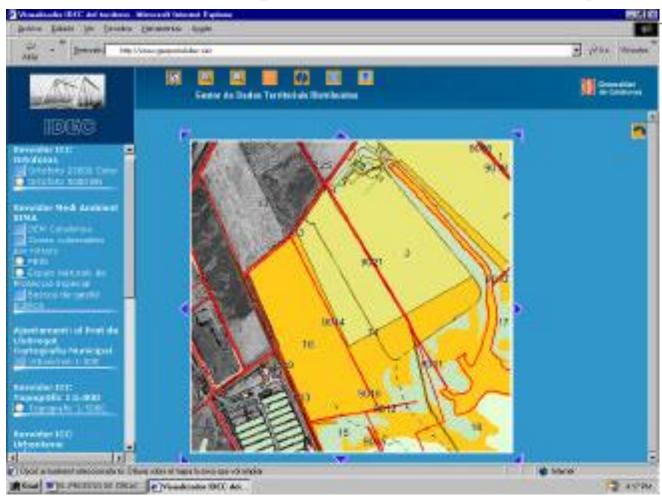
Image integrating topographic, orthophoto, environmental and urban planning data, from 3 different servers.

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Results of the Catalunya SDI study

The total direct cost to establish and operate the Catalan SDI (IDEC) over a five-year period (2002-06) was € 1.5 million, of which:

- € 325,000 for each of the first two years (2002-03) were necessary to launch the SDI,

- € 283,000 per annum to operate and develop the infrastructure in the three subsequent years.

Results of the Catalunya SDI study

The costs included the following:
- metadata creation and maintenance,
- geo-services (including geoportal, catalogue, and a client implementing OGC WMS)
- preparation of data for publication, applications, hardware and software, and data management.

Human resources represented 60 % of the costs during the launch period (the rest being capital investment), and 80 % once set up.

Results of the Catalunya SDI study

The benefits accrue at the local level through public administration efficiency benefits
- time saved in internal queries by technical staff,
- time saved in attending queries by the public,
- time saved in internal procedures,
- redesign of internal processes
  and effectiveness benefits,
- time saved by the public and by companies
  dealing with public administration.

Extrapolating the detailed findings from 20 local communes to the 100 that participated in the IDEC local project, the study estimated that efficiency benefits account for over 500 hours per month.

Results of the Catalunya SDI study
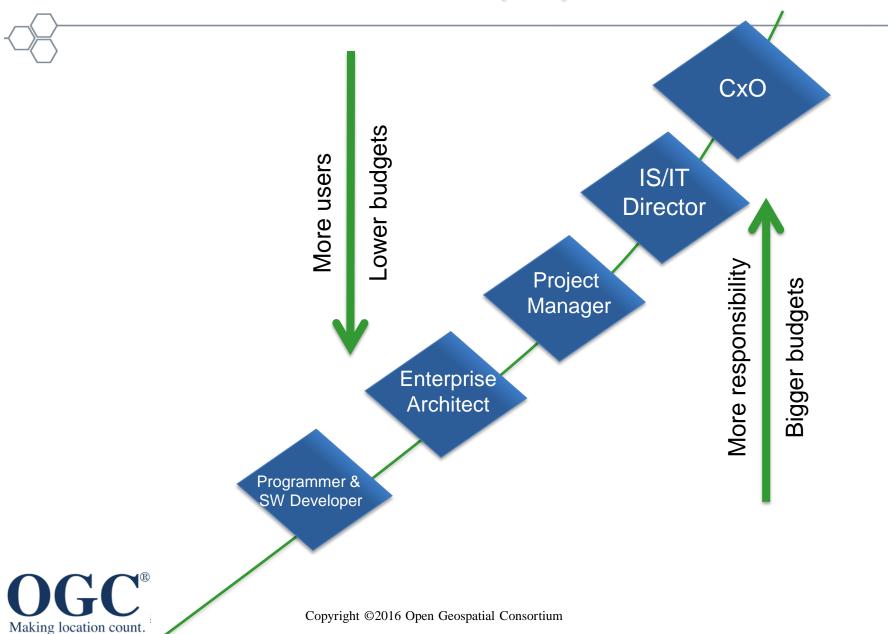
Using an hourly rate of €30 for technical staff in local government, these savings exceed €2.6 million per year.

Effectiveness savings are almost as large at approximately 480 hours per month. Even considering only the efficiency benefits for 2006 (i.e. ignoring those that may have accrued in 04-05, as well as the effectiveness benefits), the study indicates that the initial investment to set up the IDEC SDI is recovered in just four months.

The full report is available at:
http://inspire.jrc.ec.europa.eu/reports/Study_reports/catalonia_impact_study_report.pdf

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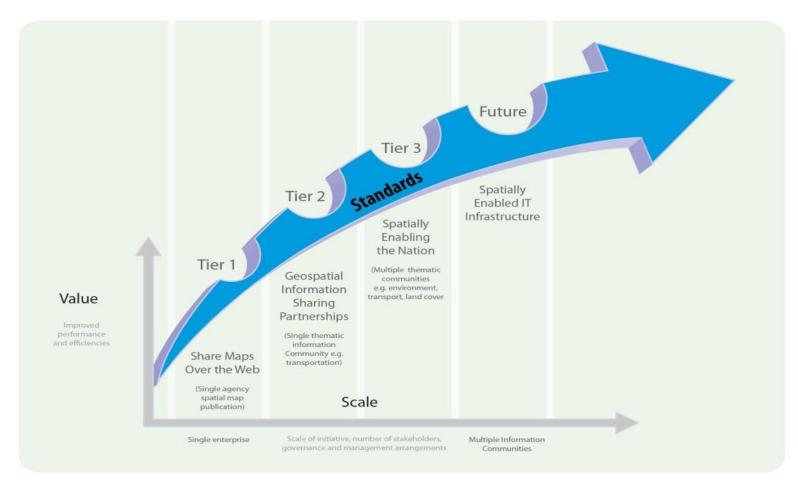
Stakeholder value propositions

CxO

IS/IT Director

Project Manager

Enterprise Architect

Programmer & SW Developer

More users

Lower budgets

More responsibility

Bigger budgets

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Standards maturity model
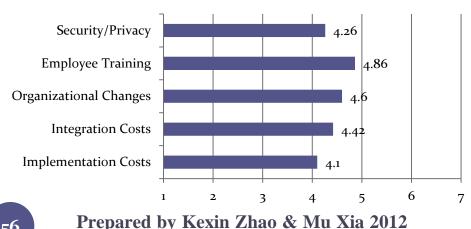
Section IV: Business Value of OGC Standards
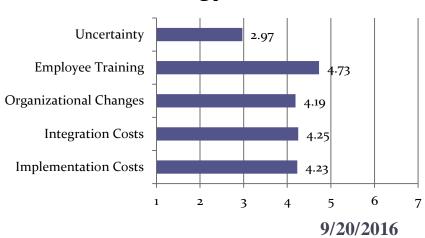
Costs

- Scale: 1-7
- Both technology users and providers expect some costs associated with OGC standards adoption
  - No 1 Costs: employee training
  - Overall, technology users expect higher costs than technology providers

Technology Users

	Value
Security/Privacy	4.26
Employee Training	4.86
Organizational Changes	4.6
Integration Costs	4.42
Implementation Costs	4.1

Technology Providers

	Value
Uncertainty	2.97
Employee Training	4.73
Organizational Changes	4.19
Integration Costs	4.25
Implementation Costs	4.23

Prepared by Kexin Zhao & Mu Xia 2012

9/20/2016

Benefits

- Scale: 1-7
- Both technology users and providers expect significant benefits from adopting OGC standards
  - No. 1 benefit: better customer satisfaction/service

Technology Users

Benefit	Score
Productivity	5.01
Customer Service	5.46
Competitive Advantage	4.93
Reduce Operating Costs	5.28
Bargain with IT Vendor	4.71
New Market	4.64
Market Expansion	4.96
Partner Coordination	5.35

Technology Providers

Benefit	Score
Reduce Development Costs	4.94
Productivity	4.62
Competitive Advantage	5.38
Reduce Operating Costs	4.98
New Market	5.22
Market Expansion	5.46
Customer Satisfaction	5.55

Prepared by Kexin Zhao & Mu Xia 2012

9/20/2016

Part II

3. **Technical approach for implementing standards**
4. **The open standards global community**

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Effective communications among disparate communities

This sign "Designed by committee"

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OGC Web Services

OGC has four main OGC Web services standards for geospatial data sharing and processing:

1. OGC Web Mapping Service Interface Standard (WMS) defines a Web API for requesting a picture of data, such as a PNG, JPEG, or GIF.

2. OGC Web Feature Service Interface Standard (WFS) defines a Web API for accessing raw vector data in formats such as GML, KML or GeoRSS and adding, updating and deleting data.

OGC Web Services

OGC has four main OGC Web services standards for geospatial data sharing and processing:

3. OGC Web Coverage Service Interface Standard (WCS) defines a web API for accessing raster data in formats, such as GeoTIFF, JPEG2000, or HDF WCS also supports adding, updating and deleting data.

4. OGC Web Processing Service Interface Standard (WPS) defines a web API for running an algorithm or model, specifying data inputs and outputs.

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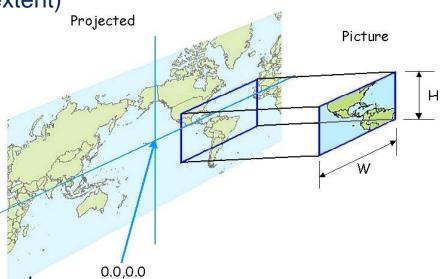
OGC Web Map Service
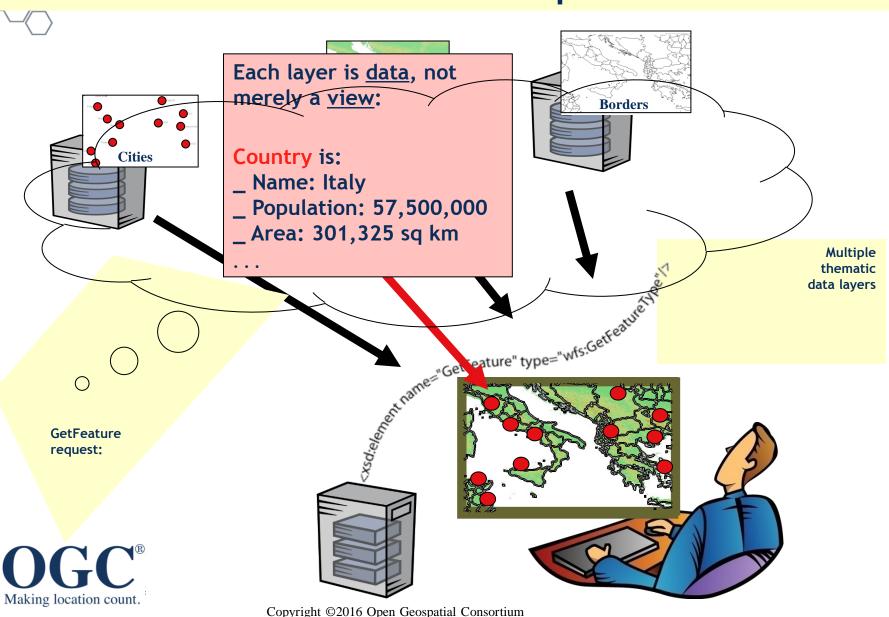
- Spatial Context
  - Spatial Reference System (EPSG)
  - Corners of map (geographic extent)
  - Image width & height

- List of "layers"
  - Layer name
  - Symbolization style

- Return Format
  - GIF | JPEG | WebCGM | SVG, etc.
  - Background info (color, transparency)
  - Exception Type = InImage | Encoded/Parseable

Real World

Projected

Picture

H

W

0.0,0.0

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OGC Web Feature Service (WFS) gets operable feature data from multiple servers

Cities

Borders

Each layer is data, not merely a view:

Country is:
_ Name: Italy
_ Population: 57,500,000
_ Area: 301,325 sq km
. . .

Multiple thematic data layers

GetFeature request:

<xsd:element name="GetFeature" type="wfs:GetFeatureType"\7

OGC Web Coverage Service
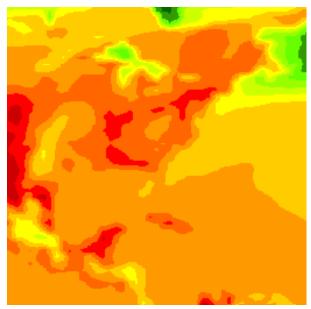
Can be used to query against multiple coverage repositories, such as imagery archives and offer selected coverage data available for use in one of several formats

– Store and serve gridded, swath, TIN or other "coverage" data in a range of formats
  (binary, HDF, GeoTIFF, NITF, NetCDF, etc.)

– Operations:

  • GetCapabilities

  • GetCoverage

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OGC Standards for Mobile

- ✓ Open GeoSMS
- ✓ GeoPackage
- ✓ OWS Context
- ✓ ARML 2

- • Points of Interest
- • 3D Visualization
- ✓ IndoorGML
- • SensorThings (IoT)

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OGC Open GeoSMS

Defines a short messaging service (SMS) encoding to exchange lightweight location information between different mobile devices or applications. Compatible with sensor web and earth imaging standards.

Open GeoSMS Standard - Core

1) Overview
2) Downloads
3) Related Links
4) Related News

1) Overview

The OGC Open GeoSMS Standard provides developers with an extended Short Message Service (SMS) encoding and interface to facilitate communication of location content between different LBS (Location-Based Service) devices or applications. SMS is the open text communication service standard most commonly used in phone, web and mobile communication systems for the exchange of short text messages between fixed line or mobile phone devices. The lightweight and easy to implement Open GeoSMS Standard facilitates interoperability between mobile applications and the rapidly expanding world of geospatial applications and services that implement OGC standard interfaces, encodings and best practices.

OGC GeoPackage

Defines GeoPackages for exchange and GeoPackage SQLite Extensions for direct use of vector geospatial features and/or tile matrix sets of earth images and raster maps at various scales.

GeoPackage Encoding Standard

1) Overview
2) Public Site
3) Downloads
4) Working Groups

1) Overview

A GeoPackage is a platform-independent SQLite database file that may contain:

- vector geospatial features
- tile matrix sets of imagery and raster maps at various scales
- extensions

Since a GeoPackage is a database, it supports direct use, meaning that its data can be accessed and updated in a "native" storage format without intermediate format translations. GeoPackages are interoperable across all enterprise and personal computing environments, and are particularly useful on mobile devices like cell phones and tablets in communications environments with limited connectivity and bandwidth. This OGC® Encoding Standard defines the schema for a GeoPackage, including table definitions, integrity assertions, format limitations, and content constraints. The allowable content of a GeoPackage is entirely defined in this specification.

▼ OGC® Standards
- ARML2.0
- Cat: ebRIM App Profile: Earth Observation Products
- Catalogue Service
- CityGML
- Coordinate Transformation
- Filter Encoding
- GML in JPEG 2000
- GeoAPI
- GeoPackage
- GeoSparql
- Geography Markup Language
- Geospatial eXtensible Access Control Markup Language (GeoXACML)
- IndoorGML
- KML
- Location Services (OpenLS)
- Moving Features
- NetCDF
- Observations and Measurements
- Open GeoSMS

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OGC Augmented Reality Markup Language

http://www.webviewservice.org/

Kaufhof

Springfield   Leffers

Remigiusstr.

Münsterplatz

www.lunch2go.at/kml   GO

Lunch2Go

Lunch2Go

Lunch2Go

Lunch2go.at

GPS

radius 31.71 mi...

Lake Helen, Florida   20.0 miles
For the high-altitude lake in Lassen
Volcanic National Park, see Lake
Helen (Lassen Peak)Lake Helen is a
city in Volusia County, Florida, United

WIKITUDE

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See also: www.opengeospatial.org/projects/groups/arml2.0swg

GeoJSON and OGC

Choose open standards based on requirement, whatever best suits your purpose or project/programme

Description of Working Group:

GeoJSON is a format for encoding data about geographic features using JavaScript Object Notation (JSON) [RFC7159].

The GeoJSON format specification was published at http://geojson.org in 2008. GeoJSON today plays an important and

This WG will work on a GeoJSON Format RFC that specifies the format more precisely, serves as a better guide for im

This WG will work on GeoJSON mappings of 'geo' URIs, reinforcing the use of RFC 5870.

This WG will work on a format for a streamable sequence of GeoJSON texts based on RFC 7464 (JSON Text Sequences) to

GeoJSON objects represent geographic features only and do not specify associations between geographic features and

Deliverables:

* A GeoJSON format specification document including mappings of 'geo' URIs
* A document describing a format for a streamable sequence of GeoJSON texts

[1] https://tools.ietf.org/html/draft-butler-geojson

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OGC Geography Markup Language

- GML: application of eXtensible Markup Language (XML)
  - XML specified by World Wide Web Consortium (W3C)
  - GML specifies XML Schemas that specify XML encoding of geographic features, their geometry and their attributes

- GML encodes digital feature data
  - Encodes features, attributes, geometries, collections, etc.
  - Determine more specific Application XML Schemas
  - GML v3, supports 2 1/2 and 3D geometry as well as complex geometry and topology

- GML3 is also available as ISO 19136

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Part II

3. ~~Technical approach for implementing standards~~
4. The open standards global community

GML application schema

GML Application Schemas and Profiles

aixm.agroxml   caaml   citygml   dwgml   fixm   gml   gwml   indoorgml   wxxm

Geography Markup Language provides the basis for domain- or community-specific "Application Schemas", which in turn support data interoperability within a community of interest. Application schemas are normally designed using ISO 19103 conformant UML, and then the GML Application created by following the rules given in Annex E of ISO DIS 19136. A discussion of the differences between an application schema and a profile can be found at http://en.wikipedia.org/wiki/Geography_Markup_Language#Application_schema.

This section of OGC Network provides information and resource links to a variety of existing and emerging GML Application Schemas and Profiles.

ALKIS/ATKIS - German National Cadastre
Aeronautical Information Exchange Model (AIXM-GML)
AgriXchange - GML Application Schema for agriculture (INSPIRE)
AgroXML - Standardized, Platform-Independent Internet Data Exchange in Farm Management Information Systems
CAAML - Canadian Avalanche Association Markup Language
Canadian Road Markup Language (for Road Network File)
CityGML
CleanSeaNet - Near real time oil spill monitoring
Climate Science Modelling Language (CSML)
Cyclone Warning Markup Language (CWML) - DRAFT
Digital Weather Geography Markup Language (dwGML)
Flight Information eXchange Model (FIXM)
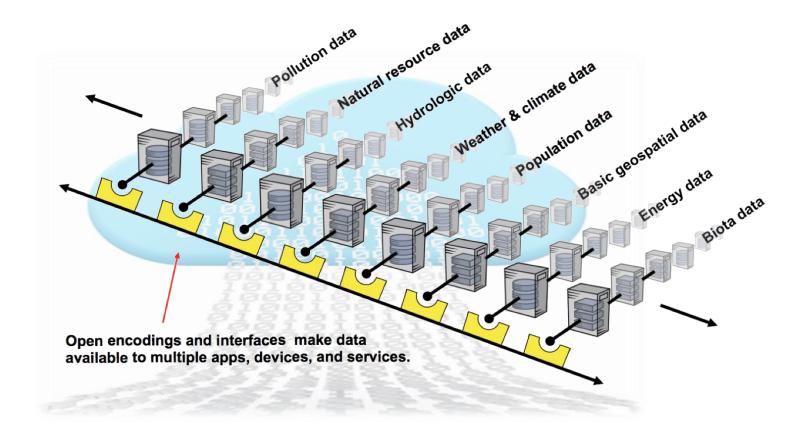
http://www.ogcnetwork.net/node/210

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Open standards and a web of data

Open encodings and interfaces make data available to multiple apps, devices, and services.

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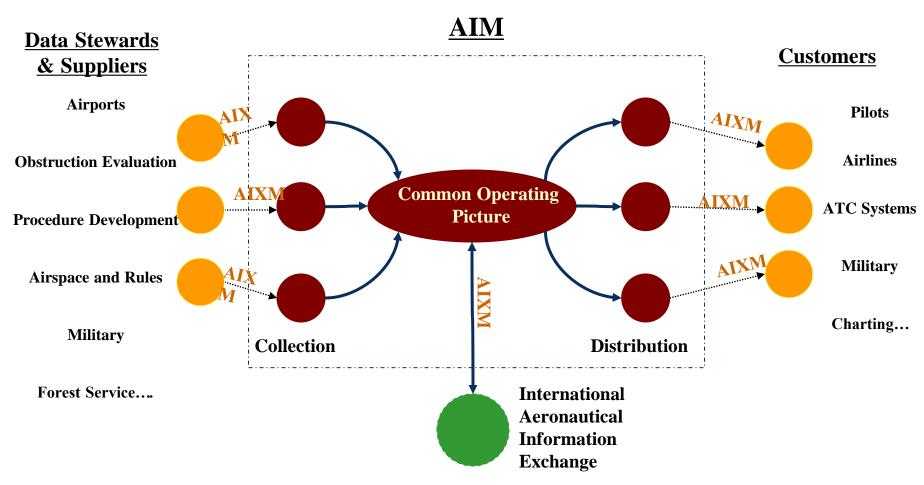
Example: AIM interoperability

AIM

**Data Stewards
& Suppliers**

Customers

Airports

Obstruction Evaluation

Procedure Development

Airspace and Rules

Military

Forest Service….

AIXM

AIXM

AIXM

**Common Operating
Picture**

Collection

Distribution

AIXM

**International
Aeronautical
Information
Exchange**

Pilots

Airlines

ATC Systems

Military

Charting…

AIXM

AIXM

AIXM

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AIXM and International Standards

Aeronautical Information Exchange Model (AIXM)

ISO 19107 Spatial	**Extensible Markup Language (XML)**
ISO 19108 Temporal	
ISO 19115 Metadata	**OGC and ISO 19136 Geography Markup Language (GML)**
Universal Markup Language (UML)	

Conceptual standards   *Exchange standards*
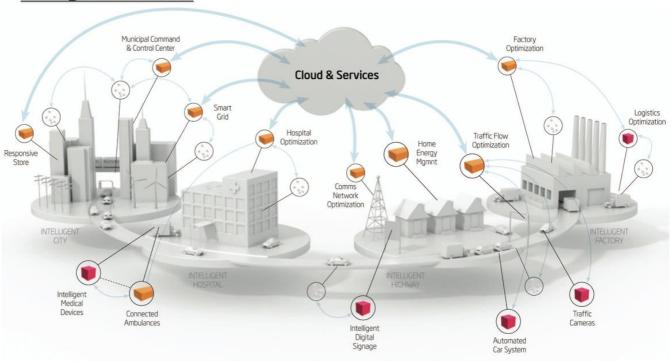
Exponential growth in data

50 billions Internet-connected things by 2020

Sensors Everywhere

(Things or Devices)
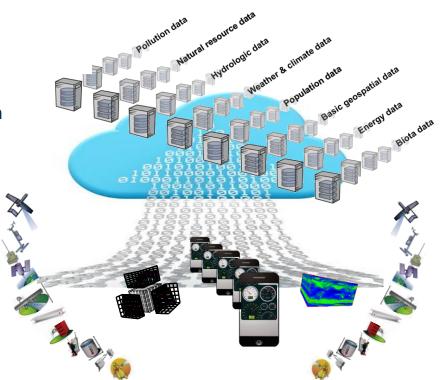
Slide source: Steve Liang, Univ. Calgary

How to harness data explosion
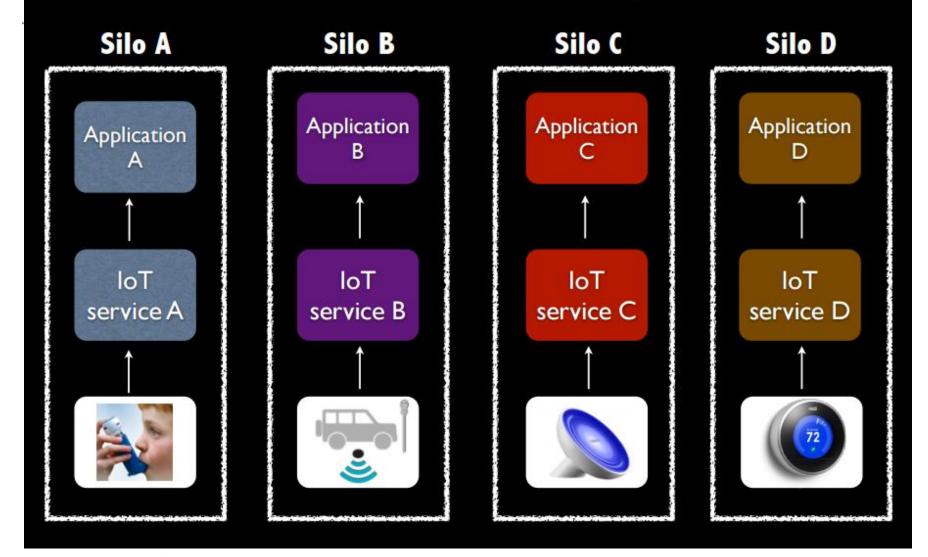
We get lots of data from an explosion of sensors, satellites, citizens, models, etc.

Pollution data

Natural resource data

Hydrologic data

Weather & climate data

Population data

Basic geospatial data

Energy data

Biota data

However, data has little value if it can't be easily discovered, assessed, accessed, aggregated, combined, passed from system to system, etc.

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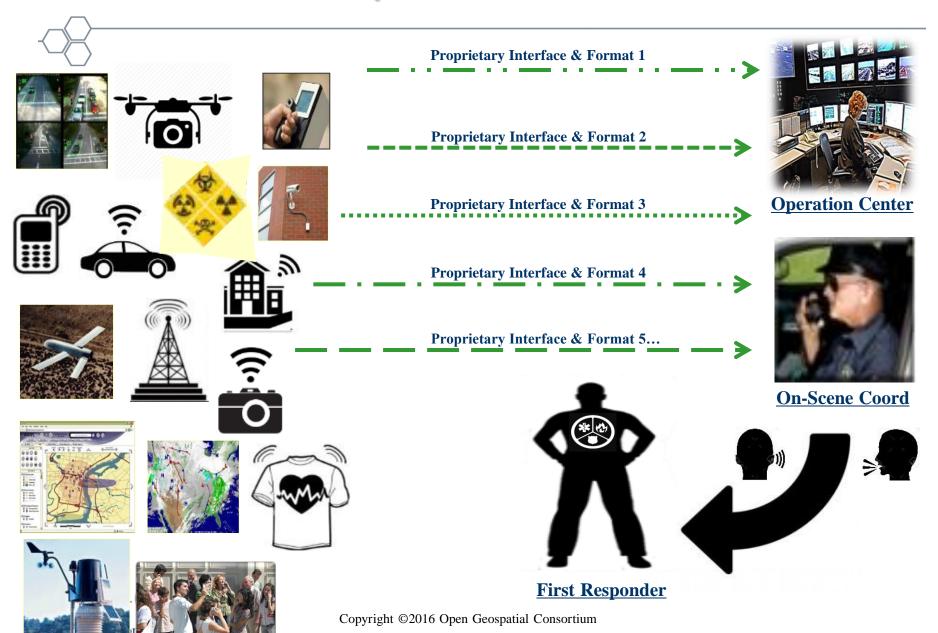
Today's IoT ecosystem
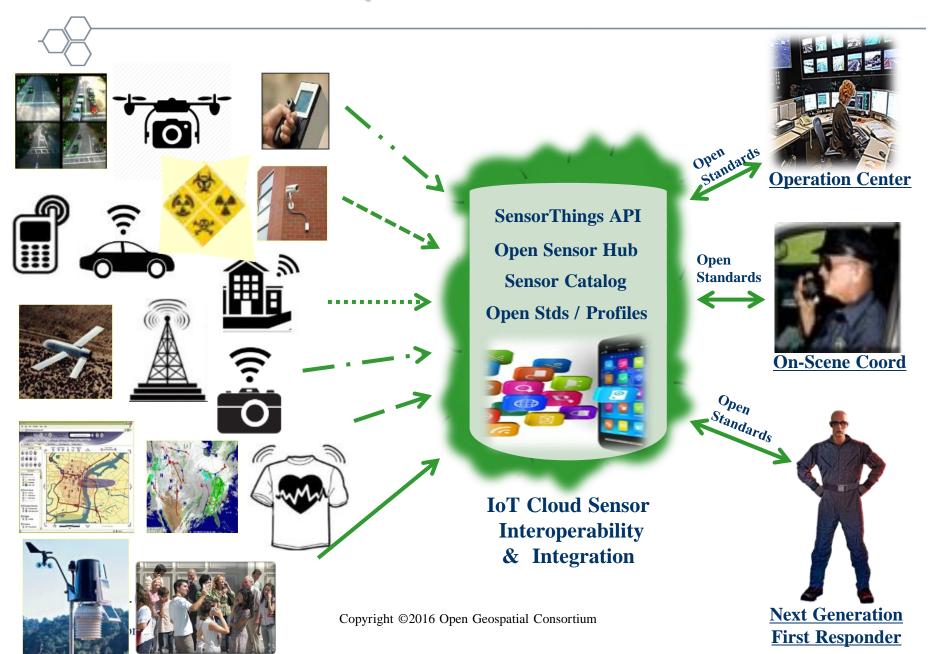
IoT for First Responders: As-Is Environment

Proprietary Interface & Format 1

Proprietary Interface & Format 2

Proprietary Interface & Format 3

Proprietary Interface & Format 4

Proprietary Interface & Format 5…

Operation Center

On-Scene Coord

First Responder
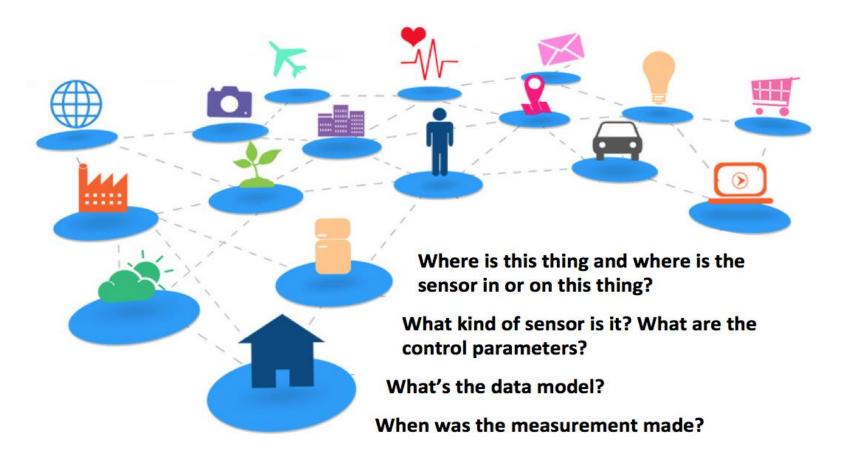
IoT for First Responders: To-Be Environment

SensorThings API

Open Sensor Hub

Sensor Catalog

Open Stds / Profiles

Open Standards — Operation Center

Open Standards — On-Scene Coord

Open Standards — Next Generation First Responder

IoT Cloud Sensor
Interoperability
& Integration

What's OGC's role?

Where is this thing and where is the sensor in or on this thing?

What kind of sensor is it? What are the control parameters?

What's the data model?

When was the measurement made?

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Handbook: Internet of Things Alliances and Consortia

Location, semantics and a focus on coordination
(**Arrows** indicate OGC Alliance Partners)

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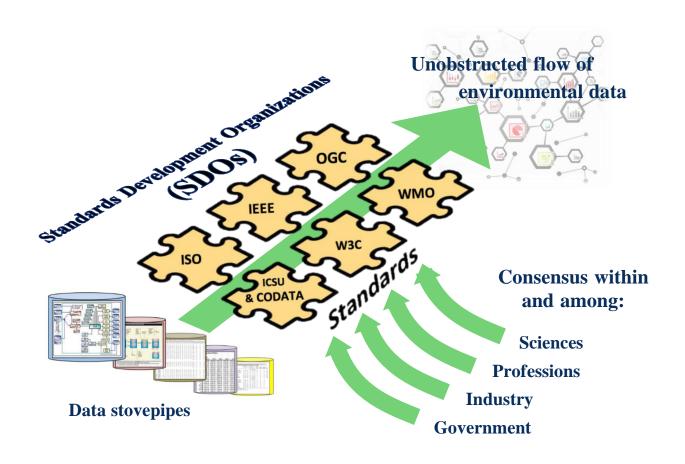
Consensus standards are important

Part II

3. Technical approach for implementing standards
4. The open standards global community

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OGC document types

- **Change Requests**
- **Public Engineering Reports**
- **Discussion Papers**
- **OGC White Papers**
- **Best Practices**
- **RFC – Candidate Standard**
- **Adopted Standards**
  - **Abstract Specification**
  - **Implementation Standard**

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OGC document criteria

- **Freely and publicly available**
- **Non discriminatory**
- **No license fees**
- **Agreed through formal consensus**
- **Vendor neutral**
- **Data neutral**

Open standards doesn't mean open source
Joint paper with
OSGeo: http://wiki.osgeo.org/wiki/Open_Source_and_Open_Standa

OGC Programs
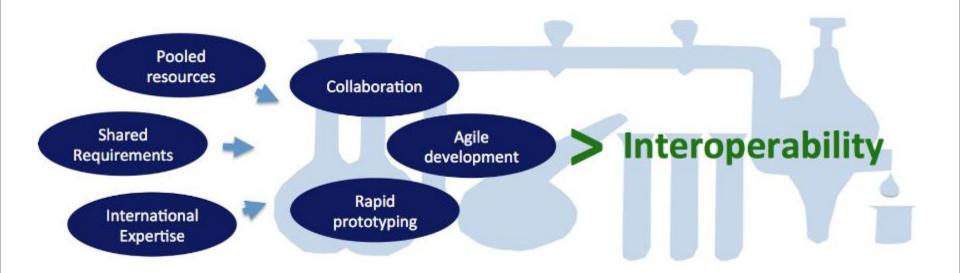
- *Interoperability Program* – global, innovative, hands-on, rapid prototyping and testing program. Designed to unite users, technology providers, researchers and others in accelerating interface development and validation, and delivery of interoperability to market

- *Standards Program* – consensus standards process similar to other industry consortia, e.g. World Wide Web Consortium [W3C] & Internet Engineering Task Force [IETF])

- *Compliance* Program – allow organizations that implement an OGC standard to test their implementations with mandatory elements of that standard

- *Communications and Outreach* Program – international outreach through education and training, encourage take-up of OGC standards, highlight business value of open standards

Rapid Interface Development

Standards Setting

Testing & Certification

Market Adoption

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OGC Interoperability Program

OGC Interoperability Program (IP)

COLLABORATION
- *Aligns technology users and providers to work collaboratively*

INNOVATION
- *Agile development environment to develop, test, and validate standards under marketplace conditions and foster innovation in the community*

SHARED COSTS
- *Effective way to share the costs of developing well-crafted standards that provide concrete foundations for future enterprise architectures*

REPEATABLE PROCESS
- *Repeatable process for building & exercising private-public partnerships to drive global trends in technology and interoperability*

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Types of OGC-IP Initiatives
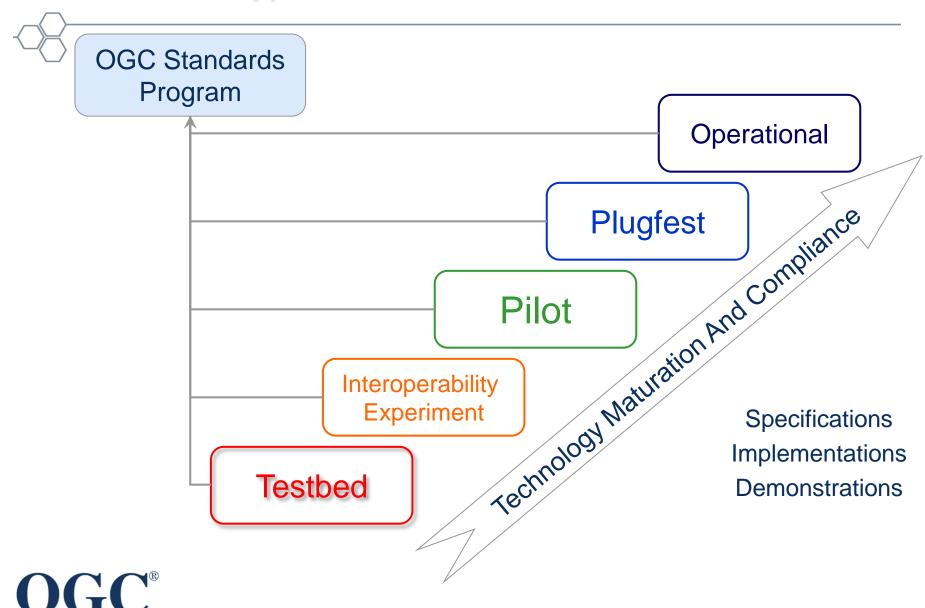
	OGC Testbed	OGC Interoperability Experiment	OGC Pilot	OGC Network
Purpose	Develop new standards & refine existing specs	Refine & extend existing standards	Test existing standards in operational environment	Persistent, widespread infrastructure
Project Management	OGC IP Team	OGC Members	OGC IP Team	OGC Members and IP Team
Sponsorship	Yes	No	Yes	Both
Participation	OGC Members	OGC Members & approved non-Members	Members & operational partners	Members & public

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Types of OGC-IP Initiatives

OGC Standards Program

Operational

Plugfest

Pilot

Interoperability Experiment

Testbed

Technology Maturation And Compliance

Specifications
Implementations
Demonstrations

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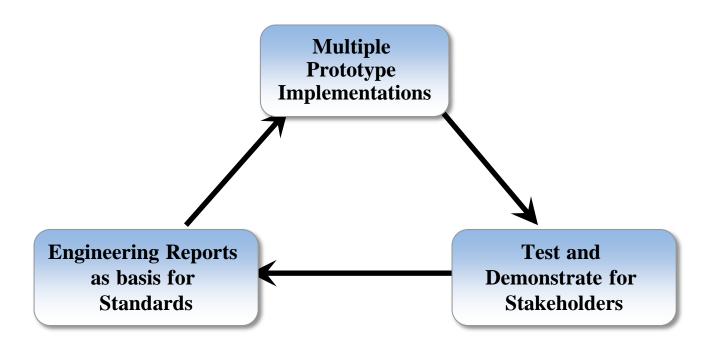
Iterative Development (yielding tested specs)

OGC Framework for Smart Cities

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

- **Influenced by:**
  - OGC's geospatial, sensor, processing & mobile standards work
  - Survey of Smart City Standards Activities:
    - JTC 1, ITU, ISO, BSI, DIN, others
  - Survey of OGC CityGML implementations

- **Goals:**
  - Pilot Smart Cities Spatial Framework:

    http://www.opengeospatial.org/blog/1886

  - Advance an OGC Best Practice for Location Enabled Smart Cities

Open Geospatial Consortium

Submission Date: 2014-11-26

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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Warning

This document is not an OGC Standard. This document is an OGC White Paper and is therefore not an official position of the OGC membership. It is distributed for review and comment. It is subject to change without notice and may not be referred to as an OGC Standard. Further, an OGC White Paper should not be referenced as required or mandatory technology in procurements.

Document type: OGC® White Paper
Document stage: Approved for Public Release
Document language: English

1   Copyright © 2015 Open Geospatial Consortium
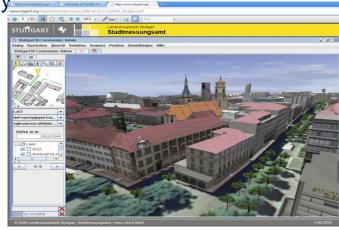
OGC®

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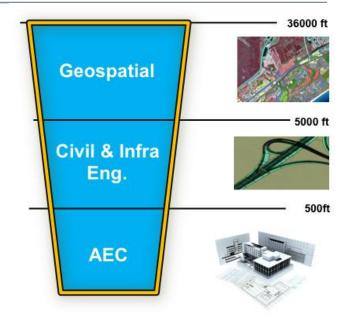
Smart Cities Spatial Standards Framework

- **Geography Markup Language (GML)** – international XML standard for spatial data on the Web

- **CityGML** - open data format for the storage and exchange of virtual 3D city models and semantics

- **IndoorGML** - modeling indoor spaces for navigation purposes

- **InfraGML** - civil engineering and survey data for land development and transportation

- **Building Information Models (BIM)** Using BuildingSmart standards

- **Sensor Web Enablement (SWE)** – integration of sensors

Source: Thomas Kolbe, Berlin TU

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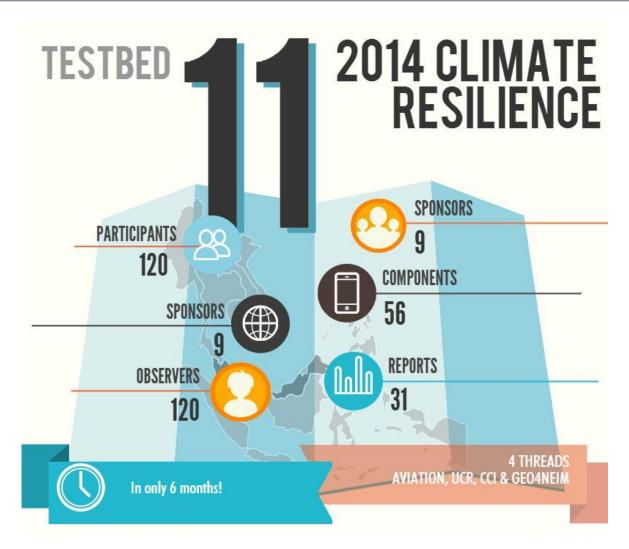
OGC Interoperability Program Testbed

OGC-IP Benefits

For Participants

Business opportunities

- Early insights and skill building

- Early visibility

- Early market deployment

- Direct influence

- Broaden market reach

For Sponsors

Significant efficiencies

- Ability to Determine Market Interest

- Accelerated process - workable interface specifications in 4-6 months

- Vendors test, validate and demonstrate interface integrity – Rapid time to market

- Leverage of other sponsor' funding to solve common/similar problems

- Significant ROI 2-3.5 overall (and as high as 25 for individual sponsors)

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OGC Compliance Program Goals

- Provide robust standard compliance solutions for geospatial communities

- Provide a process whereby compliance for OGC specifications can be tested.

- Increase systems interoperability

- Reduce technology risks

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OGC Compliance Program History
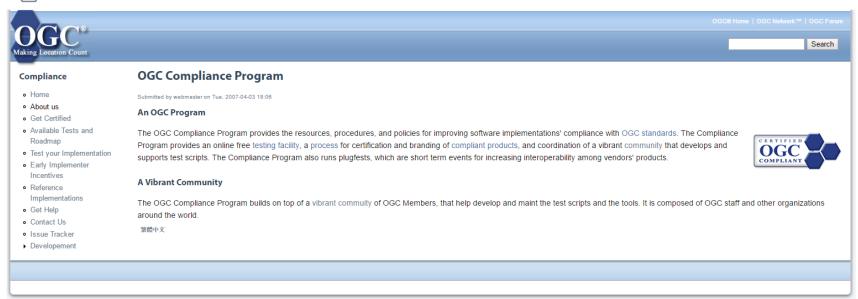
- Providing certification for 10+ years

- Web Testing Engine operational since 2007

- More than 260 compliant products in the market

OGC Compliance Testing Wiki

OGC Compliance – Software Acquisition

External identifier of this OGC™ document: http://www.opengis.net

URL for this OGC® document: http://docs.opengeospatial.or

Additional For

Internal reference number of t

OGC Compliance Overview - Guide for Software Acquisition

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Part III

- **Standards policy and industry resources**
- **Participate in the standards process**

Standards in policy

European INSPIRE Directive

European Space Agency

GeoConnections Canada

Global Earth Observation

System of Systems (GEOSS)

National legislation, e.g. India
  Japan, Netherlands…

US FGDC, USGS

US NGA,

US NOAA

UK Location Programme

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OS Geospatial Standards Policy

Through this *Standards policy*, we are seeking to achieve seven policy objectives. To:

- Enable our customers to avoid vendor lock-in, by providing data and services that conform to open standards.

- Be seen to be a thought-leader in the geospatial industry in the UK and internationally and hence provide a strong platform to allow influence in other relevant areas.

- Reduce risk to Ordnance Survey from development of inappropriate standards that we may then have to adopt, or of adopting standards that are then not widely adopted by others.

- Reduce cost by adopting existing standards rather than develop our own standards.

- Increase efficiency by increasing consistency across the business.

- Add to value of Ordnance Survey data and services by providing interoperability with those of other providers.

- Comply with legal obligations and the government's Open Standards Principles[16].

https://www.ordnancesurvey.co.uk/about/governance/policies/geospatial-standards.html

British Government Open Standards

HM Government

Open Standards in Government IT: A Review of the Evidence

An independent report for the Cabinet Office
by the Centre for Intellectual Property & Policy Management
at Bournemouth University

'This review of evidence reported in the literature on open standards concludes that adoption of an open standards policy to encourage interoperability and more competition in the procurement process is likely to be advantageous.'

'Advantages include potential cost savings as well as social benefits such as allowing greater access to and transparency of information. '

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UN-GGIM and International Standards

New York,
13-15 August 2012
Second session of the
UN Committee of Experts
on Global Geospatial
Information Management

- Request by ISO Technical Committee 211 (geomatics and geographic information) to provide a paper related to standard-setting issues in the international community, jointly with OGC and IHO
- Formal activity initiated under UN-GGIM secretariat

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).

July 2015

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).

**To help everyone
better understand
what standards to
use, when and why.**

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Joint paper Mexico and UK

National Mapping Authority Perspective: International Geospatial Standards

Lead Authors:
Gerardo Esparza, INEGI, Mexico
Steven Ramage, Ordnance Survey International, Great Britain

http://ggim.un.org/docs/meetings/GGIM4/National%20Mapping%20Authority%20Perspective%20-%20International%20Geospatial%20Standards.pdf

Part III

- ~~Standards policy and industry resources~~
- **Participate in the standards process**

OGC and Alliance Partners

- Primary alliances for standards coordination
  - Commission Europeen des Normes (CEN)
  - Digital Geospatial Information Working Group (DGIWG)
  - Internet Engineering Task Force (IETF)
  - Organization for the Advancement of Structured Information Standards (OASIS)
  - International Organization for Standards (ISO)
  - Open Mobile Alliance (OMA)
  - National Institute of Building Sciences (NIBS)
  - National Emergency Number Association (NENA)
  - Network Centric Operations Industry Consortium (NCOIC)
  - IEEE Technical Committee 9 (Sensor Web)
- Secondary alliances
  - Global Spatial Data Infrastructure Association (GSDI)
  - Web3D
  - World Wide Web Consortium (W3C)
  - Integrated Justice Information Systems (IJIS) Institute
  - International Alliance for Interoperability (IAI)
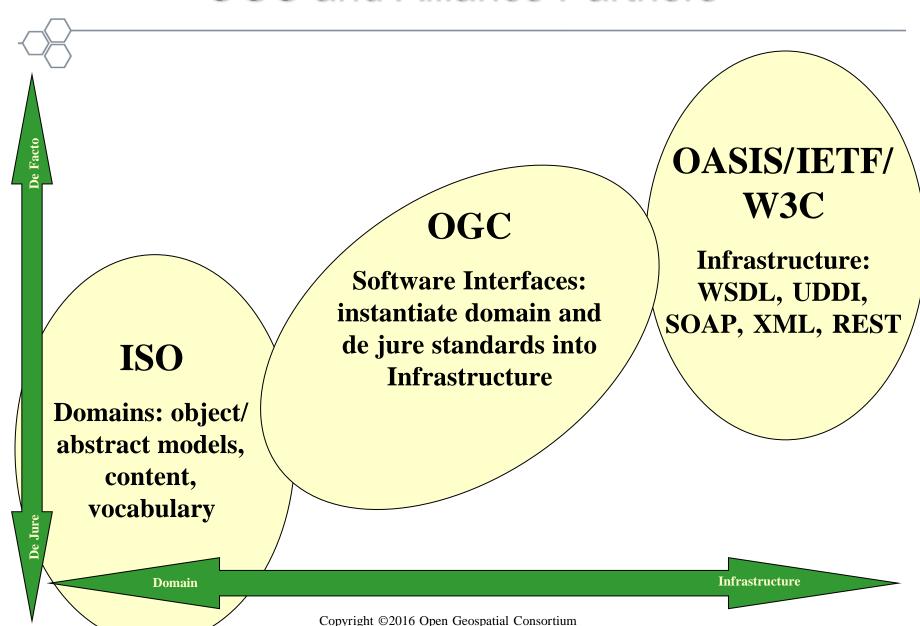 - IEEE GRSS and ICEO
  - Taxonomic Data Working Group (TDWG)

OGC and Alliance Partners

De Facto

De Jure

ISO

Domains: object/ abstract models, content, vocabulary

OGC

Software Interfaces: instantiate domain and de jure standards into Infrastructure

OASIS/IETF/ W3C

Infrastructure: WSDL, UDDI, SOAP, XML, REST

Domain

Infrastructure

Public collaboration

- Requests for Information
- Requests for Comment
- Call For Participation
- Change Requests
- OGC Fora
- OGC Network
- OGC Wikis

Change Requests

The new OGC StandardsTracker has been developed to replace the old Change Request Tool. You can now view or submit new issues or change requests via the same tool.

You will need to create an account to get started with a submission of a change request.

The below PDF documents were produced from the old tool and are available either in PDF or in the new StandardsTracker.

ArcticSpatialDataPilot

Update June 3rd, 2016:

ArcticSDP Clarifications Webinar Friday, 3 June 2016, 0900 EDT recordings available **online**!

RFQ

The Open Geospatial Consortium (OGC) and sponsors, U.S. Geological Survey (USGS) and Natural Resources Canada (NRCan), in collaboration with the Arctic Spatial Data Infrastructure Participants, announce a Request for Quotation (RFQ) and Call for Participation (CFP) in the OGC Interoperability Program's Arctic Spatial Data Pilot Phase-2 (Arctic SDP) initiative (see Press Release). The purpose of this Request for Quotation and Call for Participation is to solicit proposals in response to a set of requirements for the OGC Arctic Spatial Data Pilot Interoperability Program (IP) initiative. The RFQ has been released May 25, 2016. It is available online: ArcticSDP RFQ full package. **Responses are due: 17 June 2016.**

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OGC blog

Blog posts from OGC members, staff and guests

OGC Health Summit - Review

Tweet | Like | 9 | G+1 | 0 | Share

Post date: 5 September 2016
Contributed by: Eddie Oldfield, Owner, Spatial Quest Solutions.
The OGC Health Domain Working Group organized an OGC Health Summit, June 21, in Dublin Ireland, to bring attention to health market requirements, technical solutions, advances in geospatial standards, and implementation examples / health applications. The OGC Health Summit:

1. Convened OGC Health DWG participants, OGC members, other interested stakeholders, including 40 participants, 4 panels, 1 survey round, and 1 technology showcase.
2. Informed how geospatial standards and related technologies can benefit the health domain, by identifying key areas of need in the market, as well as identifying beneficiaries, stakeholders, key gaps / application areas, and resources.
3. Identified requirements for OGC standards, including geospatial data and web service requirements (for interoperability standards), and Interoperability work.
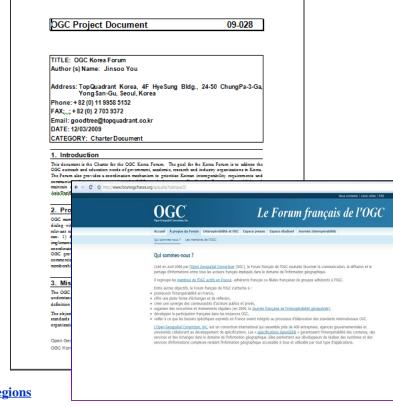
OGC fora

Organize OGC standards requirements, priorities and outreach activities consistent with language, culture, policy and political environment.

- Regional
  - Asia Forum
  - Europe Forum
  - Iberian and Latin American Forum
  - Nordic Forum

- National
  - France Forum
  - India Forum
  - Korea Forum
  - UK and Ireland Forum

http://www.opengeospatial.org/ogc/regions

OGC press

Regular news items on website and industry press

OGC's 100th Technical and Planning Committee Meetings to be held September 19-23 2016 in Orlando, Florida

Tweet | Like 4 | G+1 0 | Share

Contact:
info@opengeospatial.org

Release Date:
Monday, 29 August 2016 UTC
The Open Geospatial Consortium (OGC®) invites you to attend its 100th Technical and Planning Committee Meeting, which will be sponsored by CAE and held at the University of Central Florida from September 19-23, 2016.

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http://www.opengeospatial.org/pressroom/pressreleases

OGC network

Technical resource area: networks, domains, encodings

OGC Network™

ogcarchitecture

OGC Network™ is a window onto the dynamic, constantly changing geospatial web as described by the OGC® Reference Model (ORM). Multiple communities of interest for research in geospatial interoperability are supported, and persistent demonstration capability is provided. Here you will find **the latest information on OGC-compatible software, services, and information models** (e.g. GML profiles, SLD examples, etc.). From this site you can **quickly locate OGC-compatible geospatial web services, the latest XML schema documents**, discussion forums, and GML profile working areas. **Want to contribute?** Instructions on signing up for authoring privileges are on the help page.

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http://www.ogcnetwork.net

OGC wikis

Example of the MetOcean Domain Working Group

Welcome to the MetOceanDWG web

The Meteorology and Oceanography Domain Working Group (Met Ocean DWG) is a community orientated working group of the Open Geospatial Consortium (OGC). The group does not directly revise OGC standards, but rather enables collaboration and communication between groups with meteorological and oceanographic interests. The Met Ocean DWG maintains a list of topics of interest to the meteorological and oceanographic communities for discussion, defining feedback to the OGC Standards Working Groups (SWG), and performing interoperability experiments. The DWG covers Oceanography as well, because of the long history of collaboration and shared institutions between meteorology and oceanography. Climatology is, of course, a subset of Meteorology.
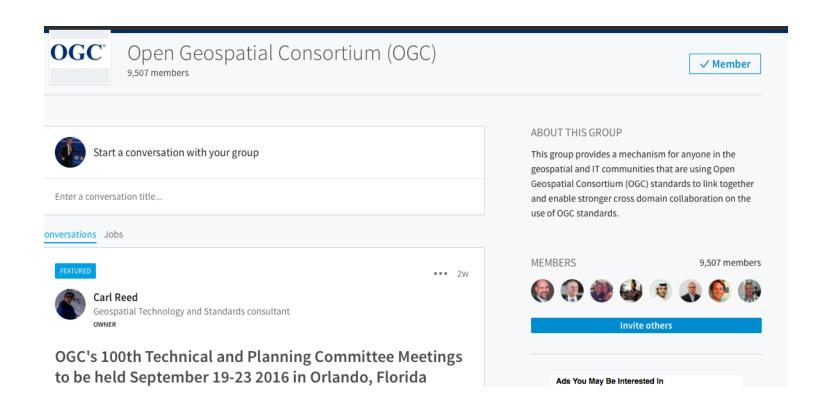
The Met Ocean DWG is intended to be a public forum for communication, and both the email list and this Twiki are open to interested parties.

- **Charter** : Please see the current Met Ocean DWG Charter. *(The original charter is at Meteo DWG Charter)* .
- **Twiki** : Anyone can edit this wiki, but, of course, responsibly. Instructions can be found on the TWiki Text Formatting Rules page.
- **Email list** : Subscribe to the public email list at : https://lists.opengeospatial.org/mailman/listinfo/meteo.dwg
- **Github** : Collaborative repositories https://github.com/OGCMetOceanDWG page.
- **Co-Chairs** : Chris Little and Marie-Françoise Voidrot-Martinez
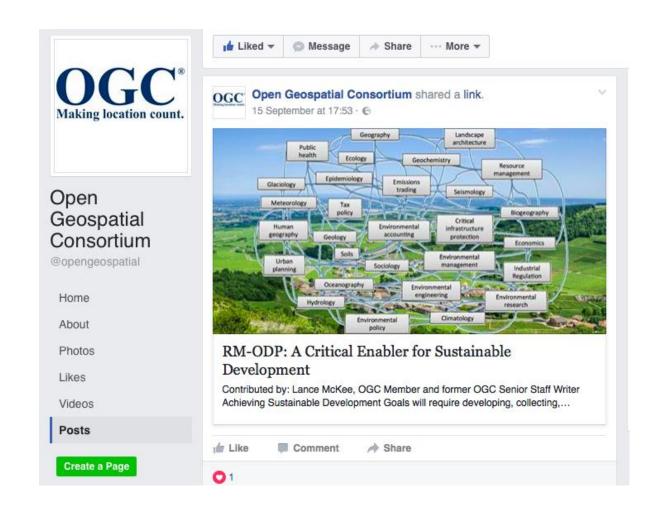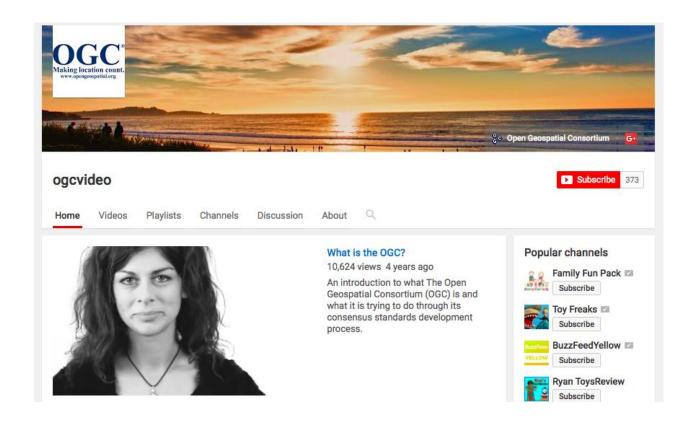
OGC on LinkedIn

OGC on Twitter

OGC on Facebook

OGC on YouTube

Get involved in the OGC

- Don't be passive, be part of standards innovation
- This is not just about the big guys fighting it out – standards are ultimately chosen by a consumer
- Ask (or demand) for your solutions to be open standards compliant
- As you build your solutions – do so in partnership with standards organisations
- Effort expended = results!

Data more valuable as shared resource

Standards make sharing possible

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Please keep in touch!

www.opengeospatial.org

@opengeospatial

Open Geospatial Consortium (OGC)

http://www.youtube.com/user/ogcvideo

Steven Ramage
Steven_ramage@outlook.com
@steven_ramage

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