OGC Innovation Program & Testbed-14
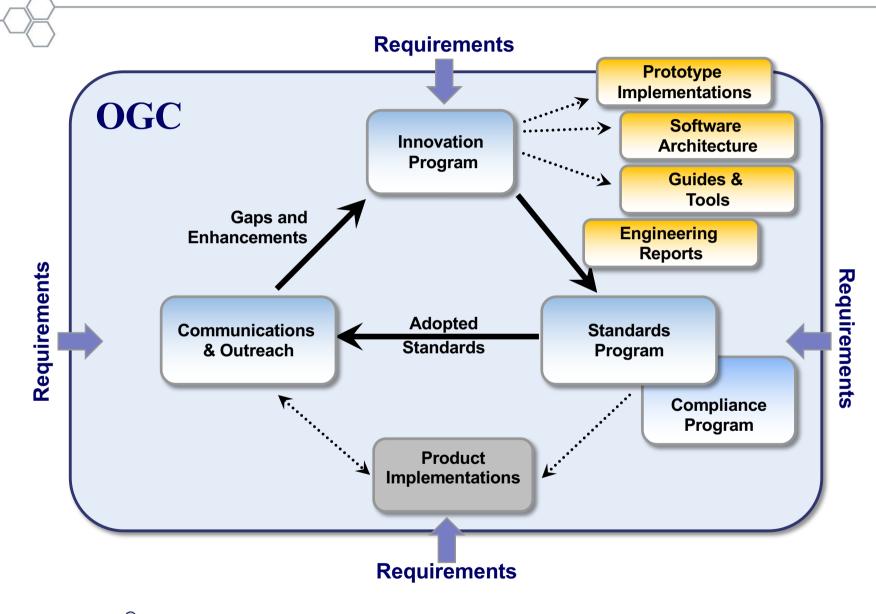
Dr. Ingo Simonis

OGC Chief Scientist & Testbed Architect

ESA/ESRIN, January 2019
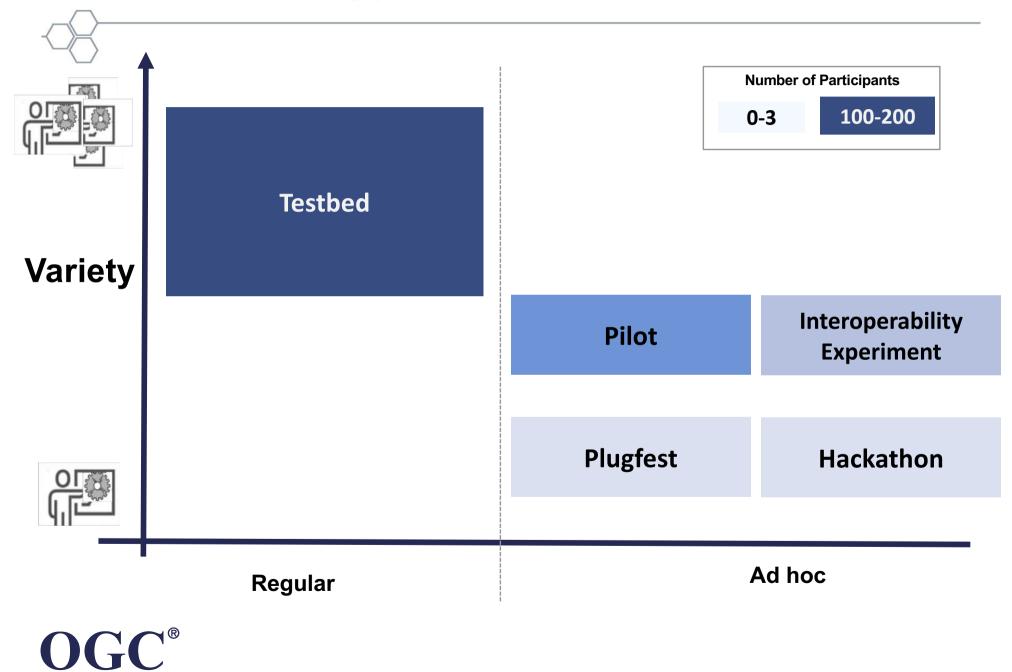
OGC IP and other OGC Programs
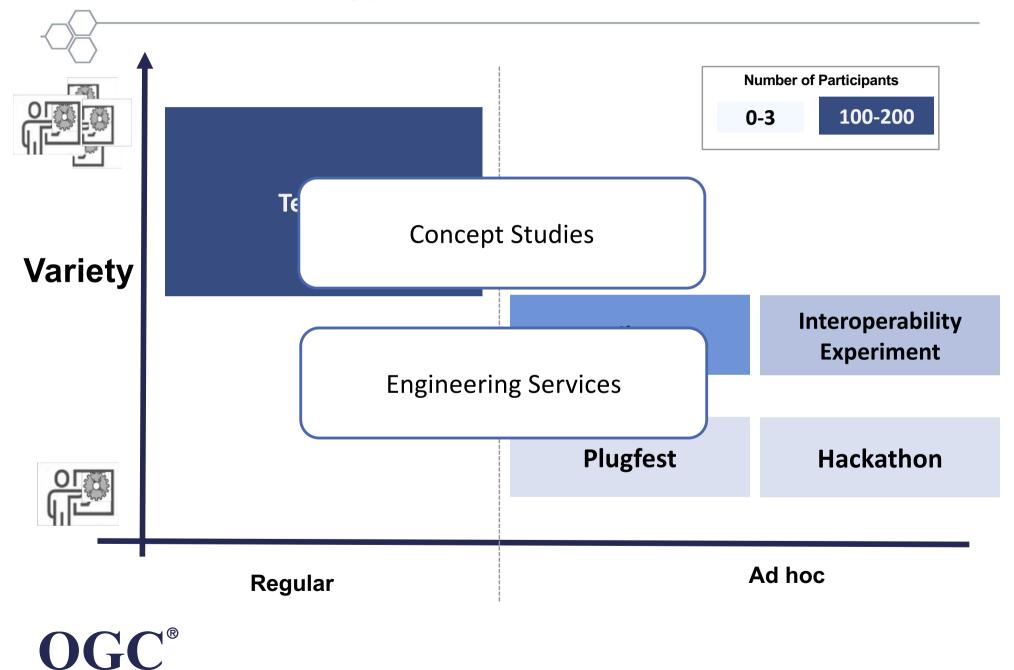
Types of Initiatives

Types of Initiatives

Variety

Te... (Concept Studies)

Engineering Services

Interoperability Experiment

Plugfest

Hackathon

Number of Participants

| 0-3 | 100-200 |

Regular

Ad hoc

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OGC Innovation Program

Solve your technical problems
Development of new technologies and optimization of existing approaches

Improve your efficiency
Optimization of processes and workflows

Optimize your interoperability
Optimization of shared models and interfaces

Find new business opportunities
Connect with new business partners

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OGC Innovation Program

Proven Process

Accelerate development, testing, acceptance and refinement of standards & best practices

Effective Process

Align industry in advancing standards in state-of-practice IT systems

Repeatable Process

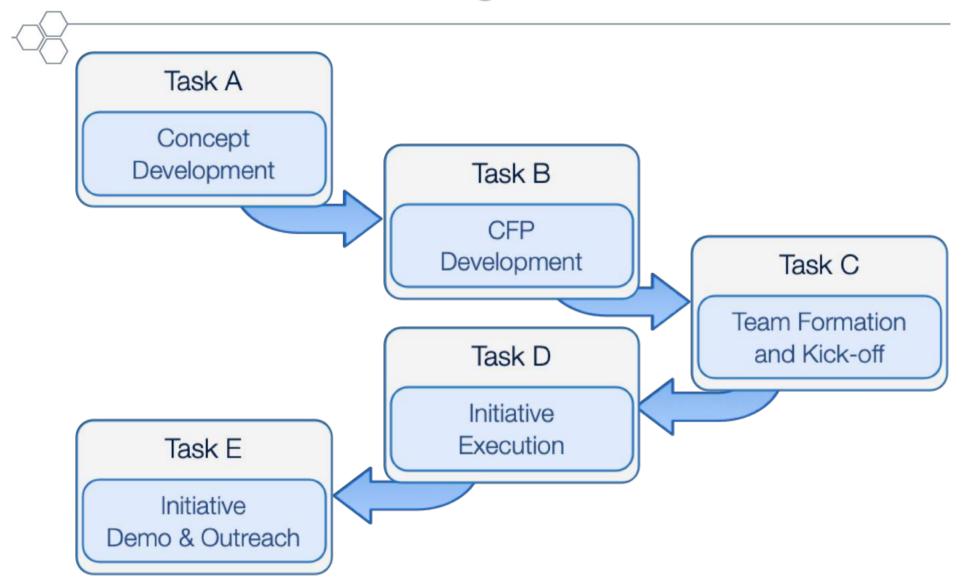Over 100 initiatives successfully conducted using proven policies and procedures since 1998

Competitive Process

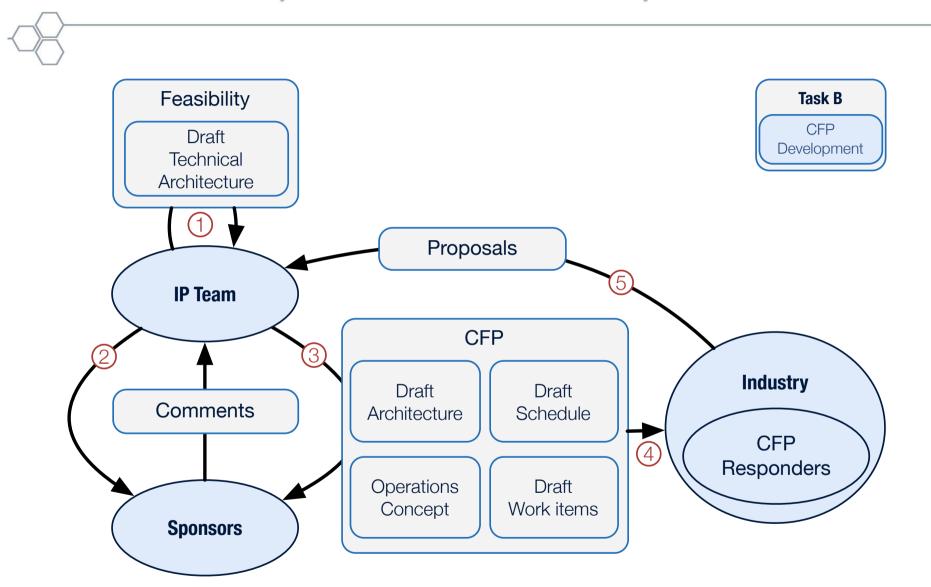Regularly yielding a high-level of industry participation and cooperation

Cost effective Process

For sharing expertise and cost while gaining early marketplace insight and advantage
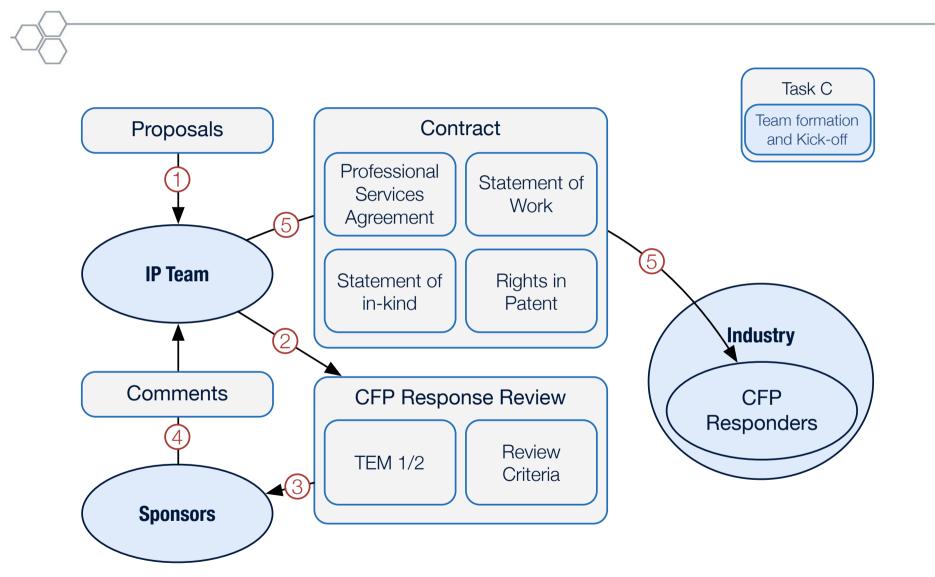
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Innovation Program Initiatives
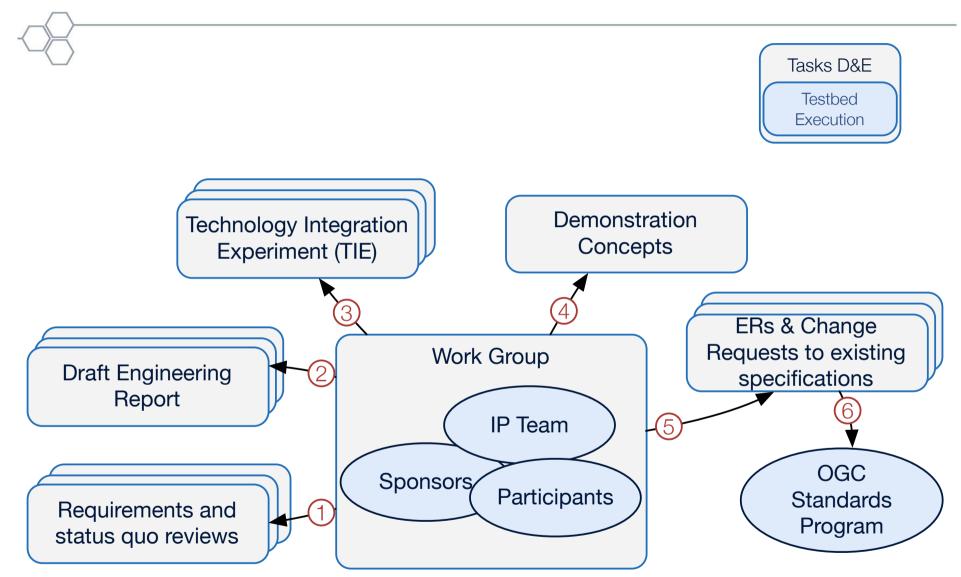
Setup & Call for Participation

Feasibility
Draft Technical Architecture

Task B
CFP Development

① ②

IP Team

③

Proposals

⑤

CFP

Draft Architecture

Draft Schedule

Operations Concept

Draft Work items

Industry

CFP Responders

④

Comments

Sponsors

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Team Formation

Proposals

IP Team

Comments

Sponsors

Contract
- Professional Services Agreement
- Statement of Work
- Statement of in-kind
- Rights in Patent

CFP Response Review
- TEM 1/2
- Review Criteria

Industry
CFP Responders

Task C
Team formation and Kick-off

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Initiative Execution

Testbed 14

> 123 organizations	> 249 individuals
$2.3 Million	
52 components	23 documents

Testbed 13

86 organizations	250 individuals
$2.2 Million	
55 components	25 documents

Testbed 12

37 organizations	210 individuals
$3.6 Million	
82 components	51 documents

Testbed 11

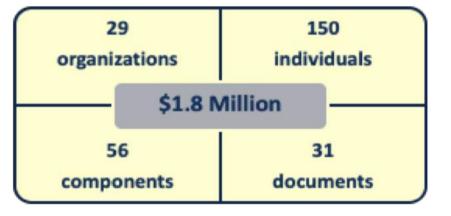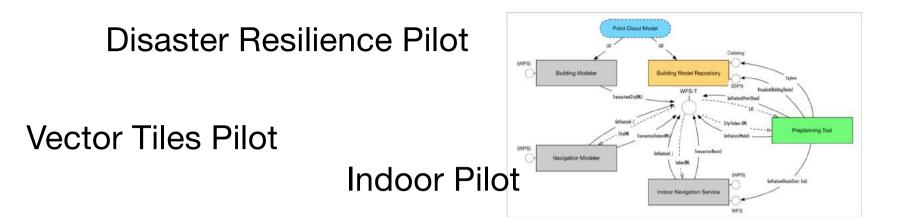|	
29 organizations	150 individuals
$1.8 Million	
56 components	31 documents

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Disaster Resilience Pilot

Vector Tiles Pilot

Indoor Pilot

CDB Vector Data in GeoPackage Interoperability Experiment
Marine Spatial Data Infrastructure (MSDI): Phase 1
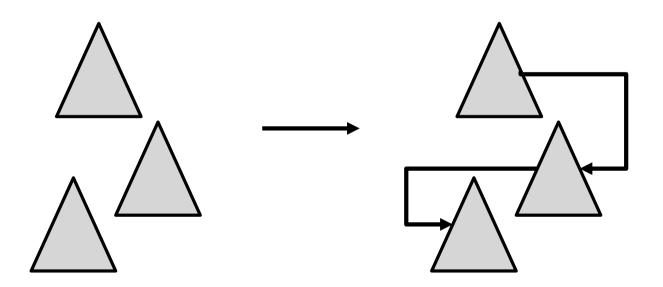Maritime Limits and Boundaries Pilot

OGC®
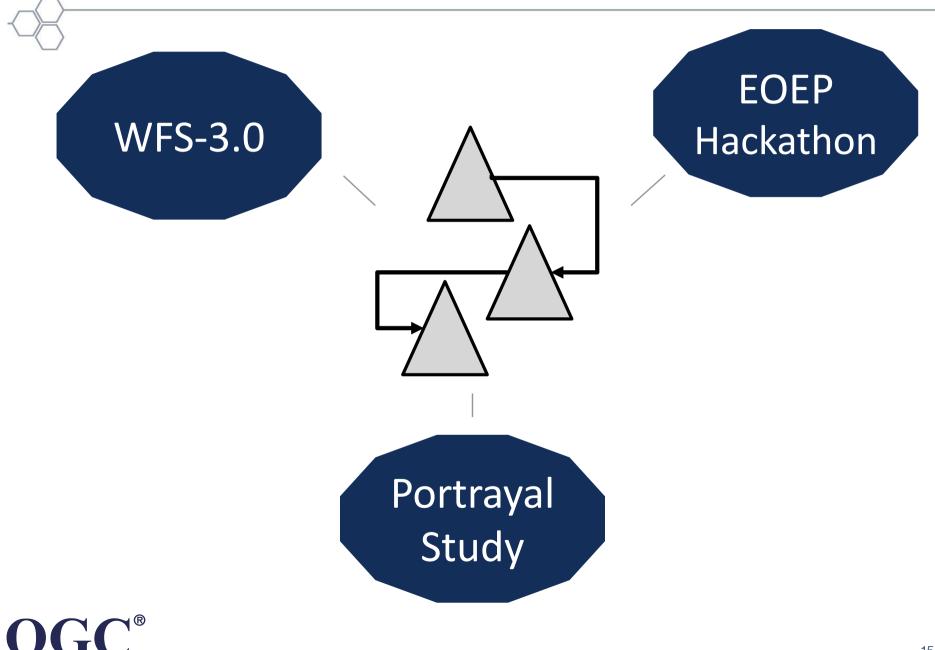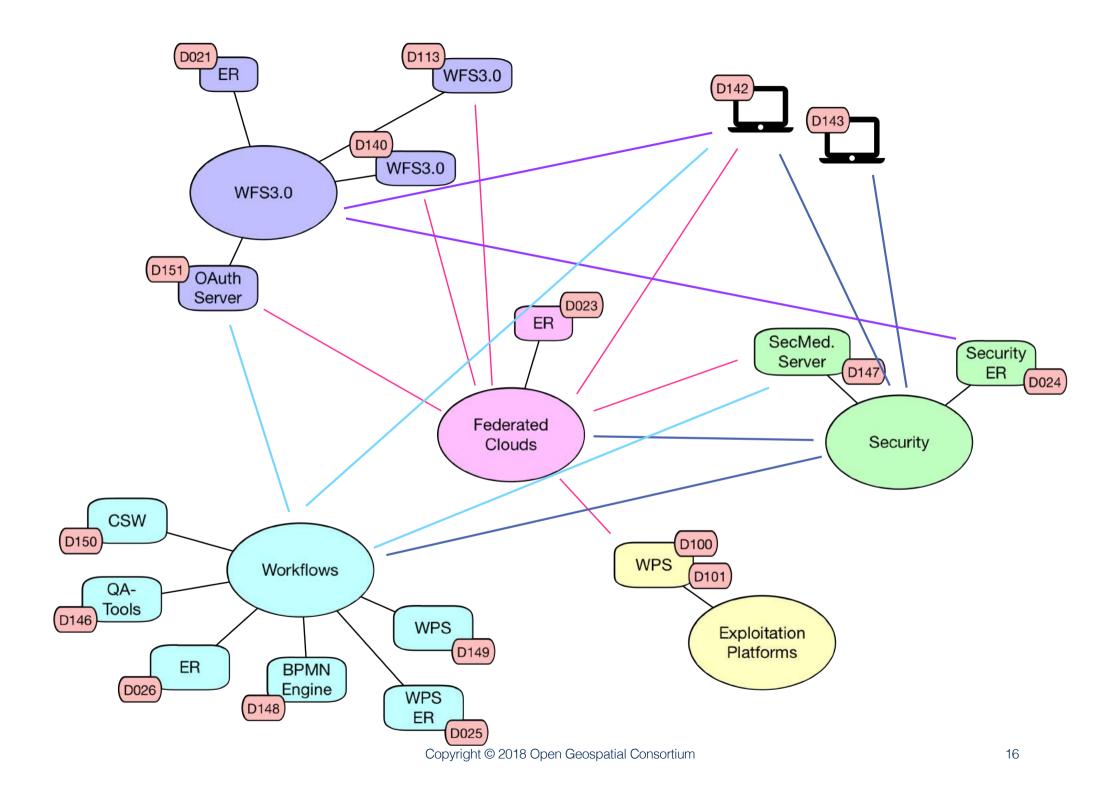
From Services to Systems

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Embedded in OGC IP / SP

WFS-3.0

EOEP Hackathon

Portrayal Study

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Sponsors

- Atos
- **European Space Agency** (ESA) / CGI
- Defence Science and Technology Laboratory (Dstl)
- European Union Satellite Centre (SatCen)
- Federal Aviation Administration (FAA) System Wide Information Management (SWIM) Program
- Geonovum
- Natural Resources Canada (NRCan)
- Ordnance Survey Great Britain
- US Geological Survey (USGS)
- US National Aeronautics and Space Administration (NASA)
- US National Geospatial-Intelligence Agency (NGA)

http://www.opengeospatial.org/projects/initiatives/testbed14

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31 Participant Organizations

- 52° North GmbH
- The Aerospace Corporation
- Arizona State University
- Army Geospatial Center / Carbon Project
- Compusult
- CREAF
- CRIM
- CubeWerx Inc.
- Deimos Space S.L.U.
- DigitalGlobe
- e-Science Data Factory
- Ecere Corporation
- Envitia Ltd
- EOX IT Services GmbH
- George Mason University
- Geoatys

- GeoSolutions SAS
- GIS.FCU
- HEIG-VD // School of Business and Engineering Vaud
- Helyx SIS
- Hobu
- Image Matters LLC
- interactive instruments GmbH
- keys
- lat/lon GmbH
- Meteorological and Environmental Earth Observation S.r.l.
- Remote Sensing Solutions Inc
- Solenix Deutschland GmbH
- Spacebel
- Steinbeis Transfer Center at HFT Stuttgart
- University of Calgary

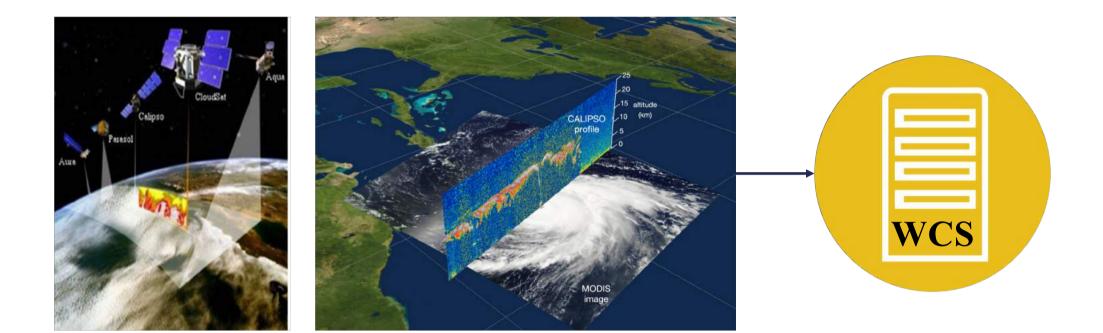**OGC**®

Threads and Deliverables

- Earth Observation & Clouds (EOC)
- Modeling, Portrayal, and Quality of Service (MoPoQ)
- Next Generation Services (NextGen)
- Compliance (CITE)

- 23 ERs + 52 components in total
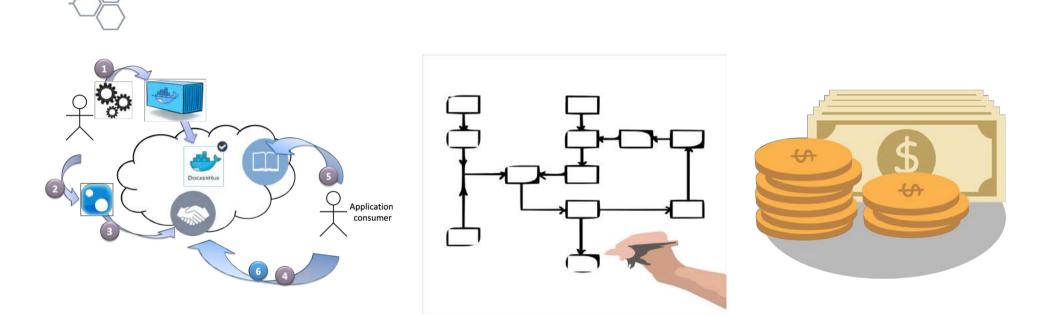
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Earth Observation & Clouds (EOC)

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Swath Coverage Data

WCS

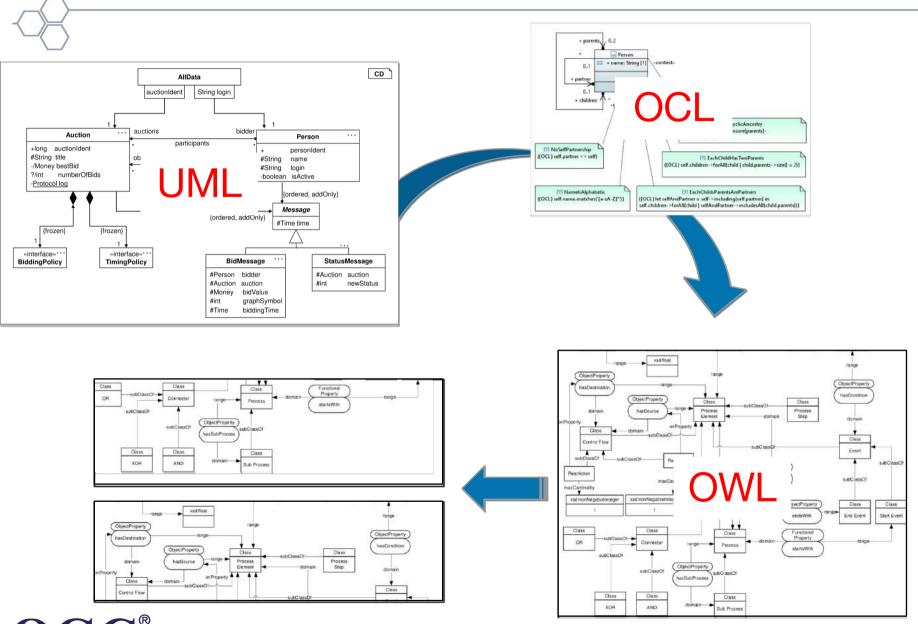| 11:30 - 12:30 | Earth Observation Exploitation Platform thread presentations - part I | EP group |
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16:20 - 16:40	Other Testbed 14 results: Earth Observation Data and Processing in Federated Clouds	Craig Lee

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EO Applications in the Cloud: Challenge

Workflow registration composed of distributed applications

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Modeling, Portrayal, and Quality of Service (MoPoQ)

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Application Schema Modeling and Conversion: Challenge

UML

OCL

OWL

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Application Schema Modeling and Conversion: Challenge

- Explore the **relationships** between **UML**-based application schemas and **OWL**-based ontologies.
- Determination of preliminary techniques for the development of **subsets of ontologies** to support different types of applications
- Initial model for defining metadata about application profiles, so they can be searched and discovered by agents.
- Increasing the understanding of state-of-the-art JSON technologies
  - Enhance ShapeChange to derive JSON Schema
  - How to map property name of JSON instance data to terms in JSON-LD

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Application Schema Modeling and Conversion: Approach

Application Schema Modeling and Conversion: Way Forward
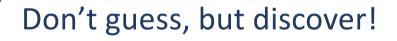
- Continue working on challenges related to conversion of UML to GML
- Develop SHACL services and build support in ShapeChange
- Improve conversion of OCL constraints
- Develop a new version of the ShapeChange JSON Schema target
- Develop JSON Schemas for ISO schemas

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Information Registries & Semantic Enablement

- SWIM: System-Wide Information Management

Don't guess, but discover!
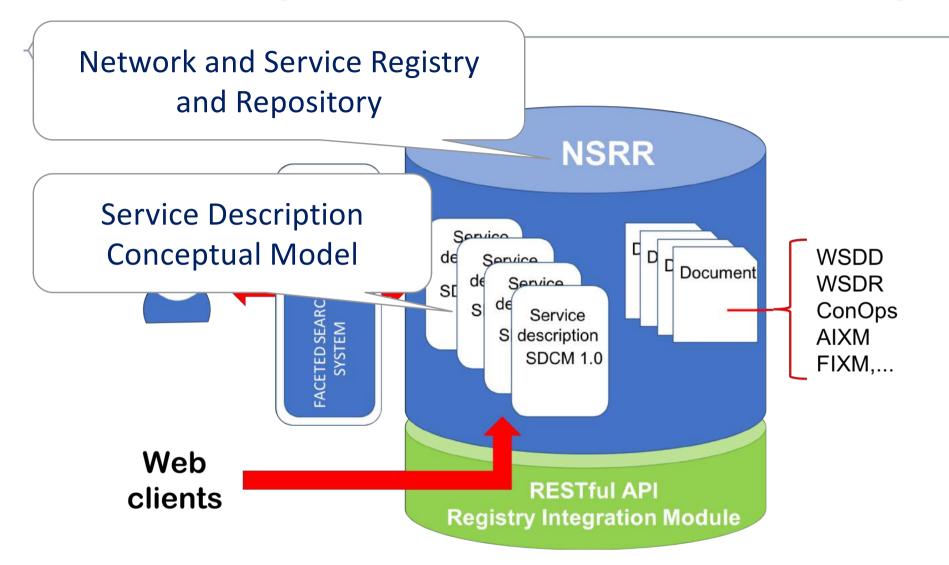
Semantic enablement
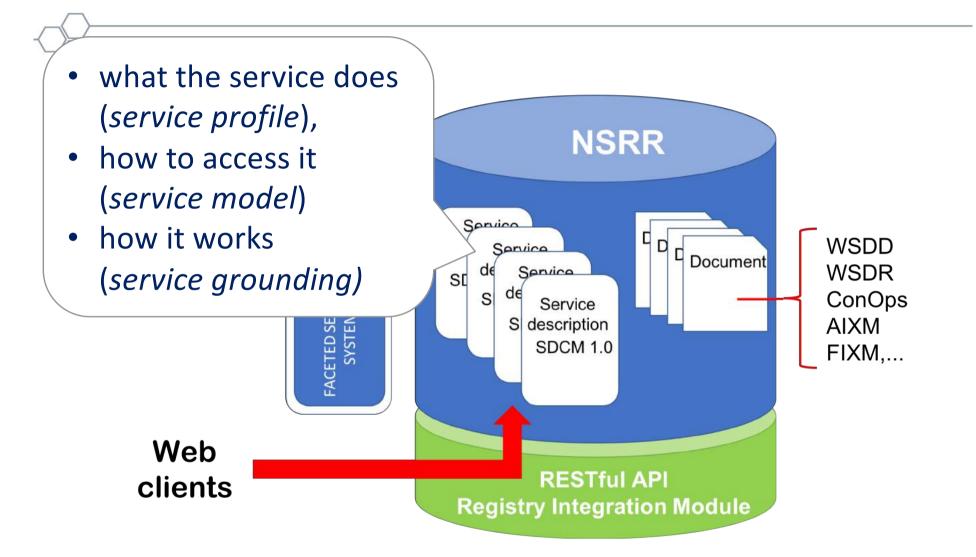
Develop a information registry

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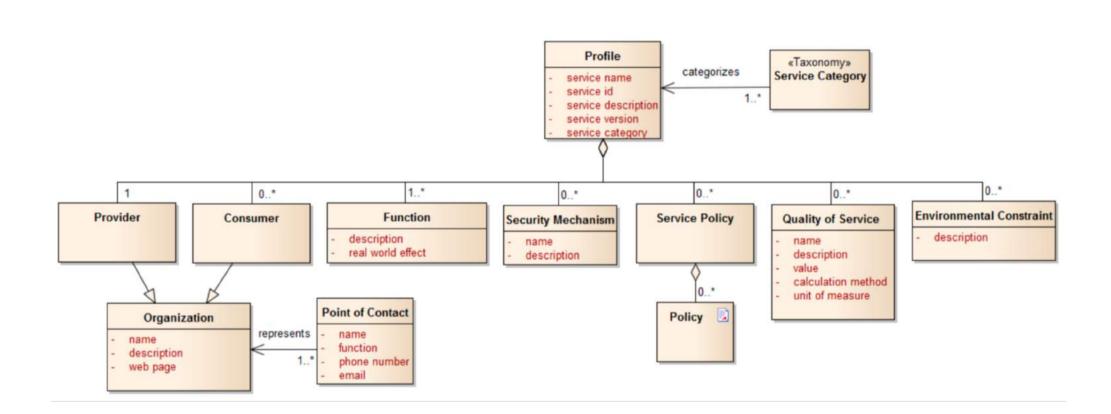
Information Registries & Semantic Enablement: Challenge

Network and Service Registry and Repository

Service Description Conceptual Model

NSRR

Service description SDCM 1.0

Document

WSDD
WSDR
ConOps
AIXM
FIXM,...

FACETED SEARCH SYSTEM

Web clients

RESTful API
Registry Integration Module

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- what the service does (*service profile*),
- how to access it (*service model*)
- how it works (*service grounding*)

NSRR

Service
Service de
SDCM
Service de
Service description
SDCM 1.0

FACETED SE SYSTEM

Document

WSDD
WSDR
ConOps
AIXM
FIXM,...

Web clients

RESTful API
Registry Integration Module

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SDCM 2.0 Service Profile

Semantic Information Registry

- Annotation data Model

- Linked Data principles

- URLs as entry points for clients to access required data

NSRR

Service Description SDCM

Semantic Information Registry

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Discovery

FROM:

Which service provides [runway true bearing] *(Domain-specific)*

Which service provides [wind measurement] *(Domain-specific)*

TO:

Which service provides [runway true bearing] *(Domain-specific)* information from [East Cost] *(Geo.)* [airports] *(Admin.)* ?

Which service provides [wind measurement] *(Domain-specific)* at [Washington Dulles Airport] *(Administrative)* ?

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Way Forward

Architecture

- Semantic resources (Datasets, Services, Maps, Layers, Documents, etc.) are essential to allow tagging

- ATM ontologies and thesauri are currently available for download only

- Semantic resources should be published by a vocabulary management system

Metadata
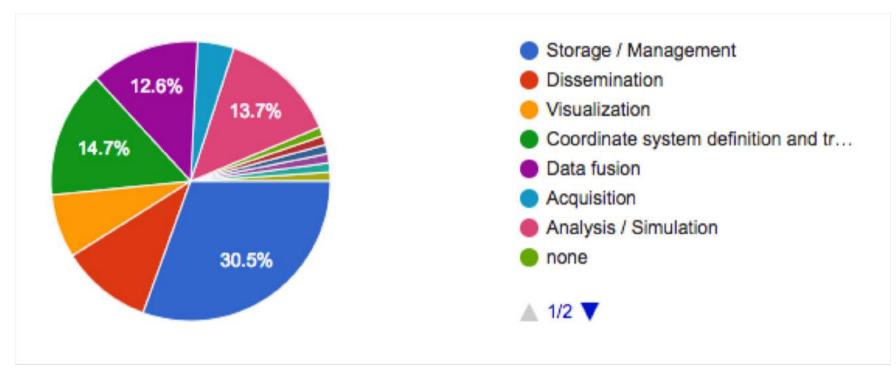
- SWIM focuses on service metadata, but lacks links to data

- Metadata about data should be formalized using GeoDCAT-AP

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LiDAR Point Cloud Data Handling: Challenge
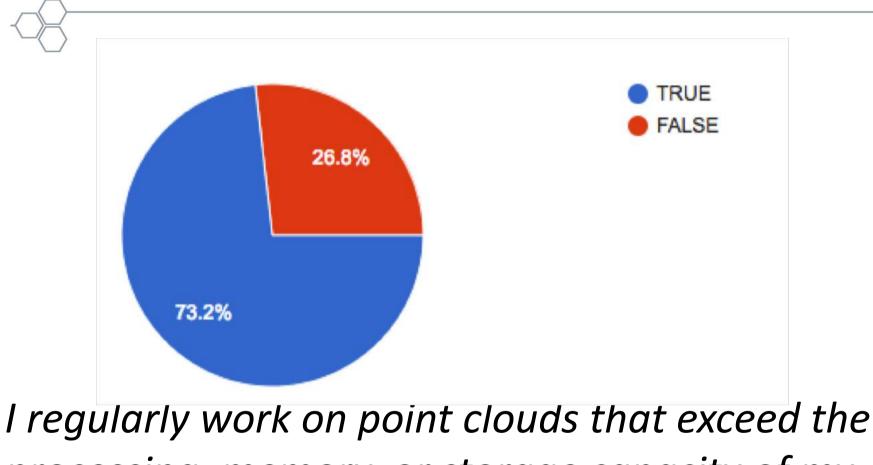
Do you experience software interoperability challenges when working with point cloud data?

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LiDAR Point Cloud Data Handling: Challenge

Pie chart legend:
- Storage / Management
- Dissemination
- Visualization
- Coordinate system definition and tr…
- Data fusion
- Acquisition
- Analysis / Simulation
- none

1/2

Pie chart values: 12.6%, 13.7%, 14.7%, 30.5%

During what phase do you encounter the MOST software interoperability challenges?

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LiDAR Point Cloud Data Handling: Challenge

I regularly work on point clouds that exceed the processing, memory, or storage capacity of my workstation or laptop.

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Research Questions

- What is unique about point cloud data in relation to other geospatial data?

- Why is a Web service for point clouds needed?

- What is the expected data volume of point cloud data?

- Do existing Web service standards within OGC already address the point cloud challenge?

- Describe the challenges of point cloud Web services in relation to other kinds of web services such as those based on Web Map Service (WMS), Web Feature Service (WFS), and Web Coverage Service (WCS) standards

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LiDAR Point Cloud Data Handling: Approach

- Identify requirements for use, storage, and transmission of point cloud data

- Investigate **five current Web service software packages**:

  - ESRI **I3S** [https://github.com/esri/ pointcloud],
  - Cesium **3D** Tiles [https://github.com/AnalyticalGraphicsInc/3d-tiles]
  - **Greyhound** [https://greyhound.io],
  - **PotreeConverter** [https://github.com/potree/PotreeConverter],
  - **Entwine** [https://entwine.io])

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Status Quo

Testbed-14 found out that the **market** is still **missing** an **openly specified format** with the following features:
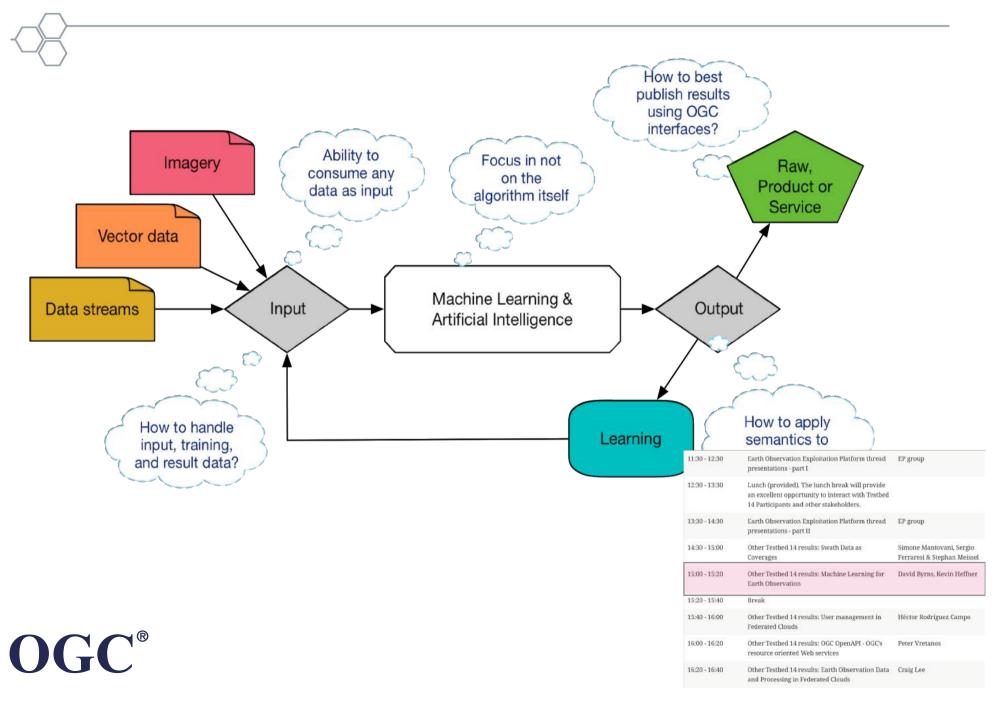
a) Spatially accelerated access

b) Point cloud-appropriate compression with no intellectual property restrictions

c) Flexible data schema

d) Platform (JavaScript, Java, native) flexibility

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LiDAR Point Cloud Data Handling: Way Forward
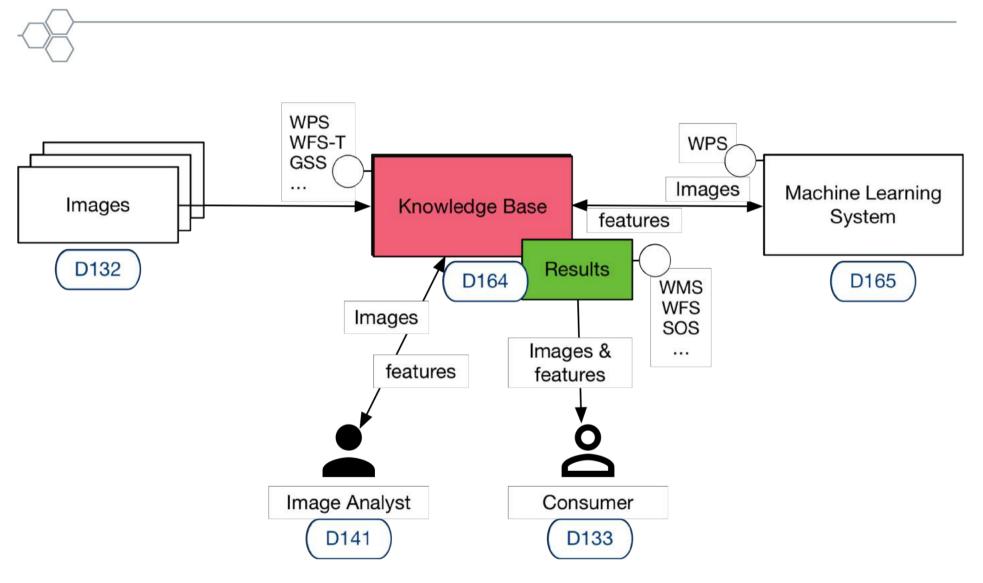
For Web service specifications coming from OGC, the following additional requirements must be considered:

- **Static tiling approach** aligned with WMTS and GeoPackage
- Suitability for **archival data storage and transmission** in addition to progressive access over HTTP network protocols
- Downstream application performance sensitivity to data organization

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Machine Learning, Deep Learning & Artificial Intelligence

Approach

Approach

catalogue of metadata about models, available images, available features, and information on previous model execution/training

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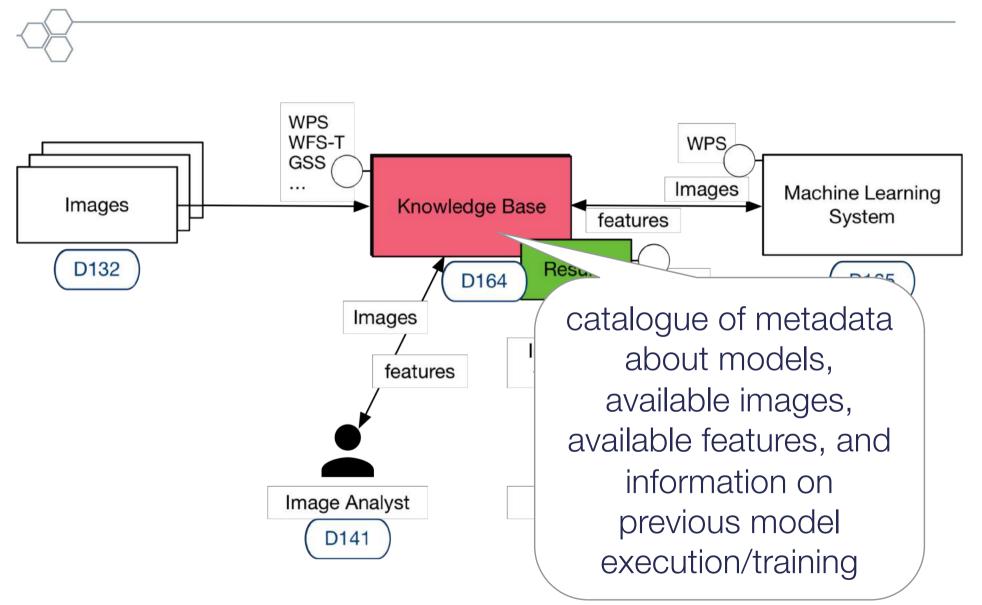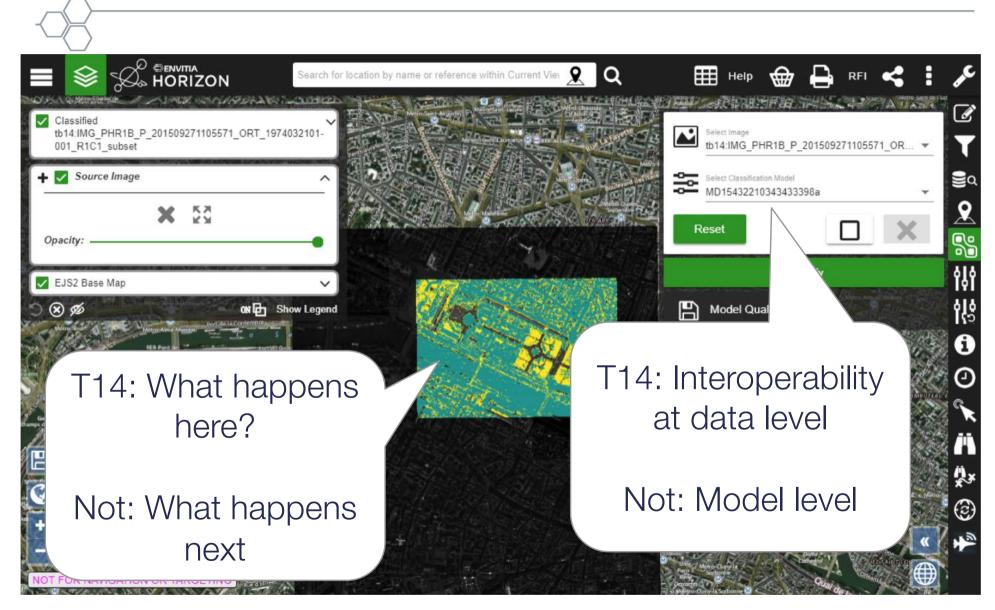
Way Forward

MapML: Challenge

How can we make maps truly accessible to everyone in a default web browser?

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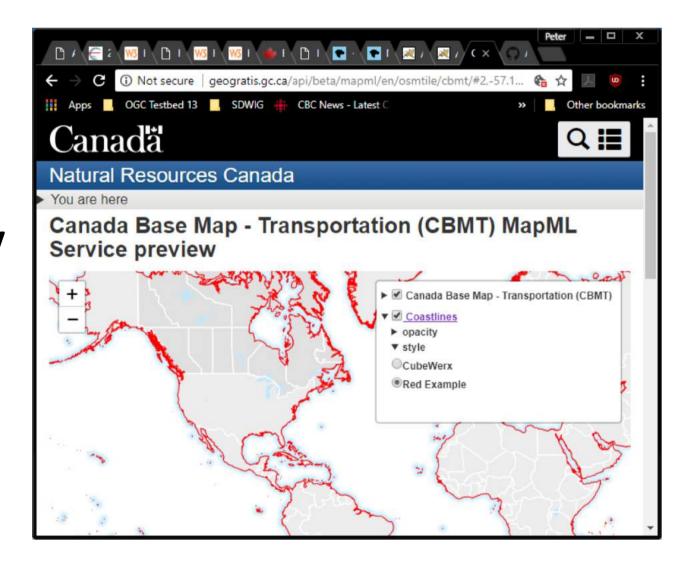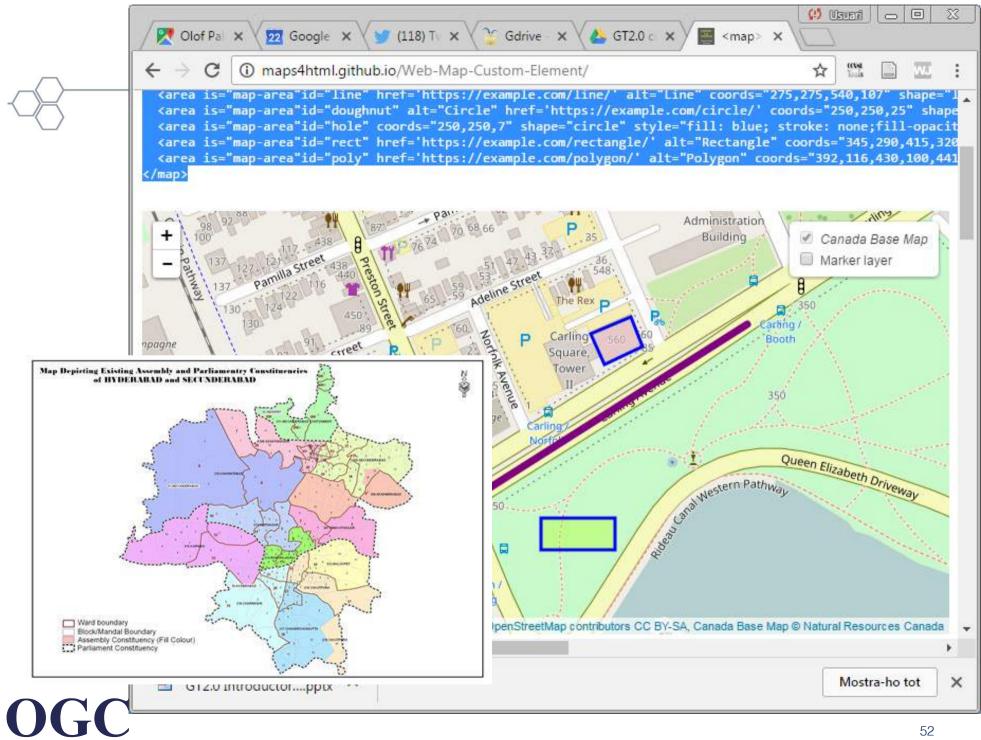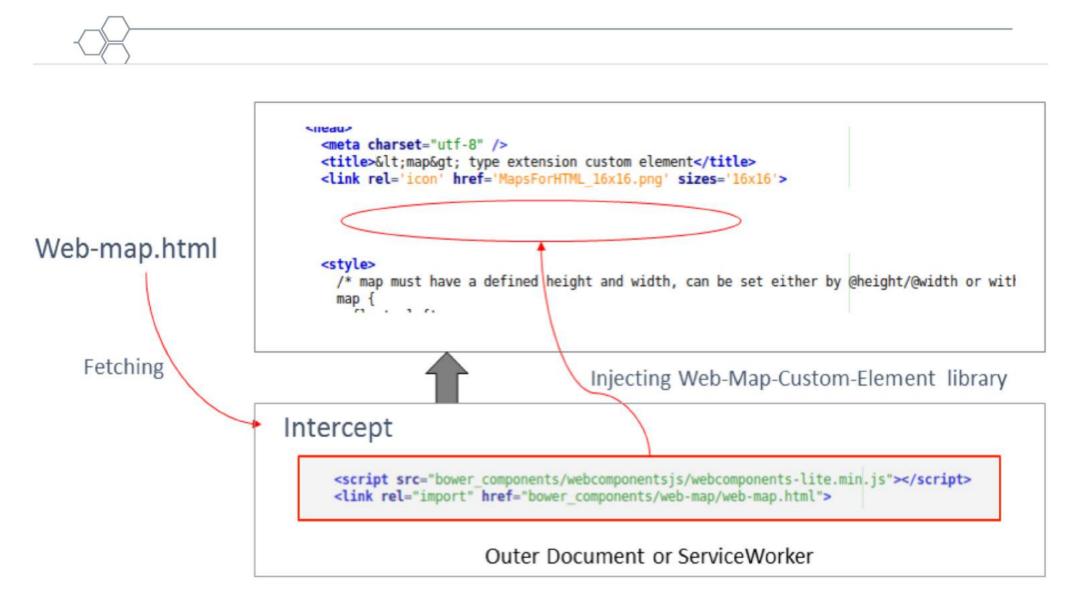
Image Maps vs. MapML

Service Worker

Web-map.html

Fetching

Injecting Web-Map-Custom-Element library

Intercept

Outer Document or ServiceWorker

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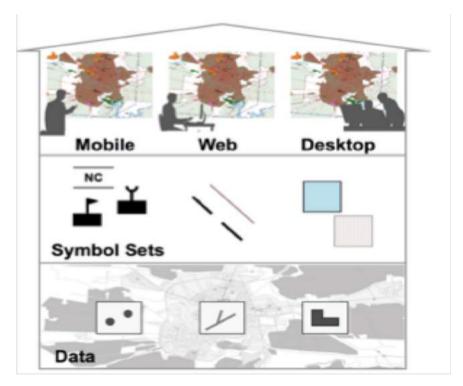
MapML: Way Forward

- The next generation of OGC services can integrate MapML files more easily.

- Potential use of MapML for social media.

- Increase functionality of MapML with full integration with the OGC standards baseline and future generations of OGC standards for maps and tiles.

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Portrayal Challenge

Given the same data and symbols, provide the same (or as similar as possible) portrayal in each user's computing environment.
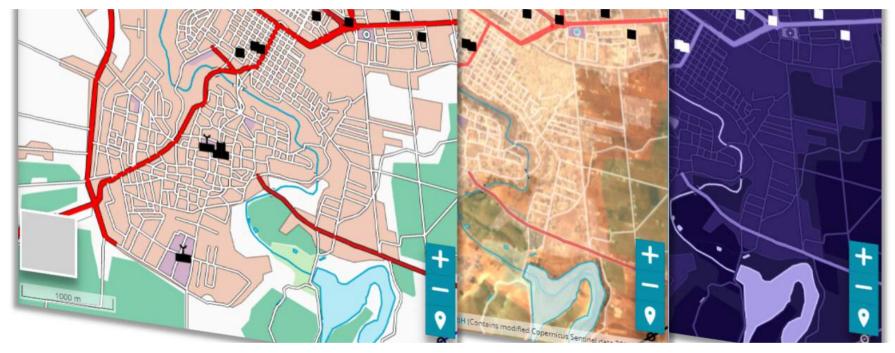
The Key Point is to have "**One Conceptual Model** and **Multiple Encodings**"

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Testbed 14: Portrayal

- A first look at harmonizing styling capabilities from different languages and rendering engines

  - SLD/SE, CartoCSS, GeoCSS, Mapbox GL styles, GNOSIS CMSS

- One conceptual model, multiple encodings

- Paving the way to styles interoperability / translation

- Cascading styling rules (inheriting default styling)

- Expressions for selectors as well as symbolizer values

- Experiments focused on WMTS, WMS and GeoPackage

- *CityGML and AR* and *Vector Tiles Pilot* leveraging portrayal work, WFS and further advancing concepts

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Portrayal: Way Forward

Open Portrayal Framework

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CityGML and Augmented Reality
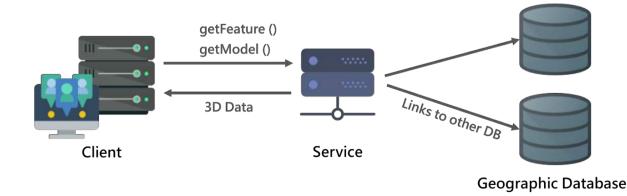
Fully integrated view of urban spaces using Augmented Reality (AR) content and CityGML content

Testbed 14: CityGML & Augmented Reality

- Sources:
    - CDB (NYC)
    - 3D buildings shapefile (Washington, D.C.)
    - Additional OpenStreetMap and COLLADA 3D pipelines data
- Intermediate CityGML data model (from shapefiles)
- WFS Service / Client interface with extensions:
    - GetFeature tiles or point/radius, referencing 3D models
    - GetModel, GetTexture
- E3D format for compact representation of 3D models
- 2 services, 2 clients (iOS / ARKit, Android / GNOSIS)

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Testbed 14: CityGML & Augmented Reality

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Quality of Service & Experience: Challenge
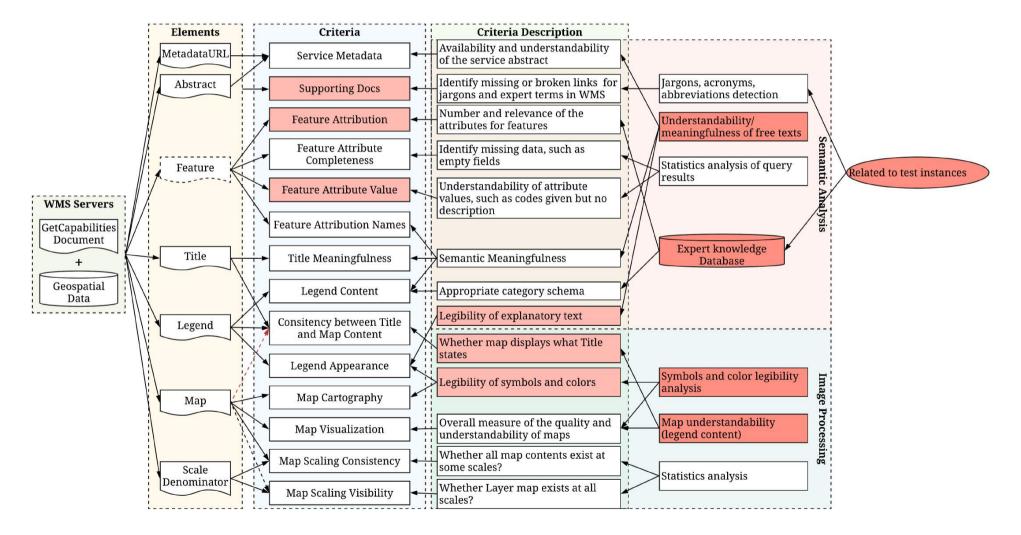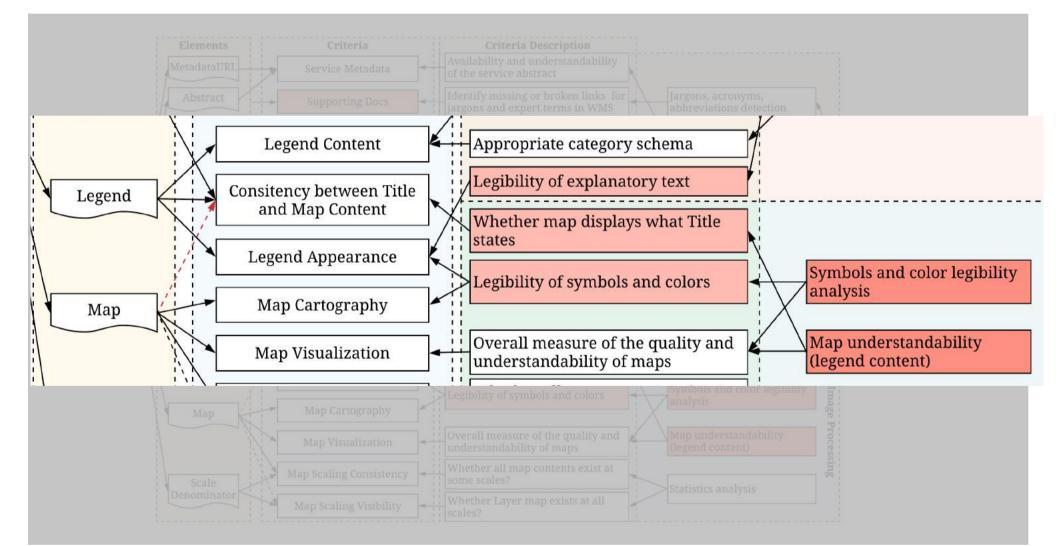
- Quality of Service: Technical reliability and performance of a network service.

- Quality of (User) Experience: A holistic, qualitative measure of the customers' experience of the application or service.

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Quality of Service & Experience: Challenge

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Quality of Service & Experience: Challenge
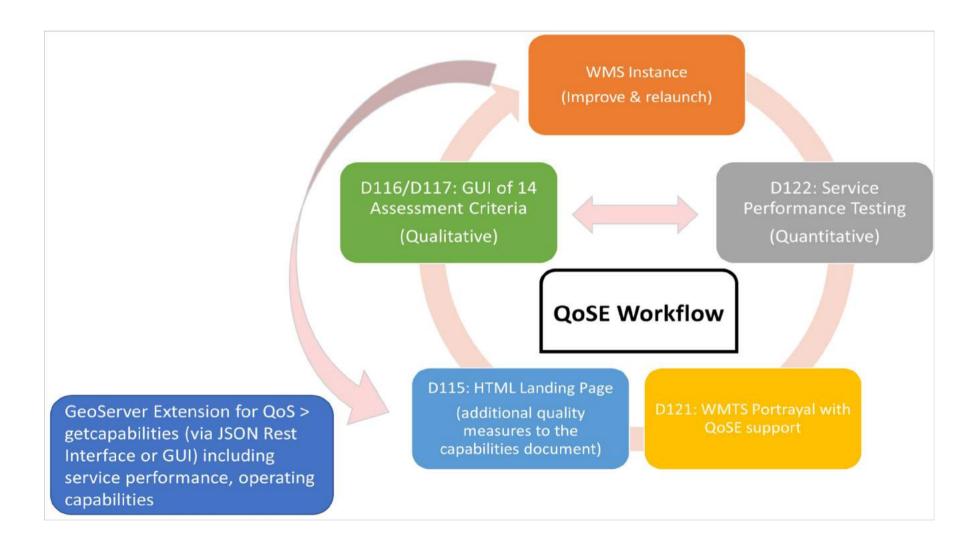
Quality of Service & Experience: Approach

WMS Instance
(Improve & relaunch)

D116/D117: GUI of 14
Assessment Criteria
(Qualitative)

D122: Service
Performance Testing
(Quantitative)

QoSE Workflow

GeoServer Extension for QoS >
getcapabilities (via JSON Rest
Interface or GUI) including
service performance, operating
capabilities

D115: HTML Landing Page
(additional quality
measures to the
capabilities document)

D121: WMTS Portrayal with
QoSE support

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Quality of Service & Experience: Way Forward

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Next Generation Services (NextGen)

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WFS 3.0

- Migrating WFS 2.0 into the new Web-era
- Security built in
- Tested with workflows
- Complemented by complex feature study

Time	Session	Presenter
11:30 - 12:30	Earth Observation Exploitation Platform thread presentations - part I	EP group
12:30 - 13:30	Lunch (provided). The lunch break will provide an excellent opportunity to interact with Testbed 14 Participants and other stakeholders.	
13:30 - 14:30	Earth Observation Exploitation Platform thread presentations - part II	EP group
14:30 - 15:00	Other Testbed 14 results: Swath Data as Coverages	Simone Mantovani, Sergio Ferraresi & Stephan Meissel
15:00 - 15:20	Other Testbed 14 results: Machine Learning for Earth Observation	David Byrns, Kevin Heffner
15:20 - 15:40	Break	
15:40 - 16:00	Other Testbed 14 results: User management in Federated Clouds	Héctor Rodríguez Campo
16:00 - 16:20	Other Testbed 14 results: OGC OpenAPI - OGC's resource oriented Web services	Peter Vretanos
16:20 - 16:40	Other Testbed 14 results: Earth Observation Data and Processing in Federated Clouds	Craig Lee

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Develop a resource-oriented approach to service complex queries such as "Get all buildings having one or more ground surfaces whose CityGML LoD 2 geometry intersects with a given geometry."

(note: Ground Surface is a nested feature in CityGML).

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Complex Feature Handling: Approach
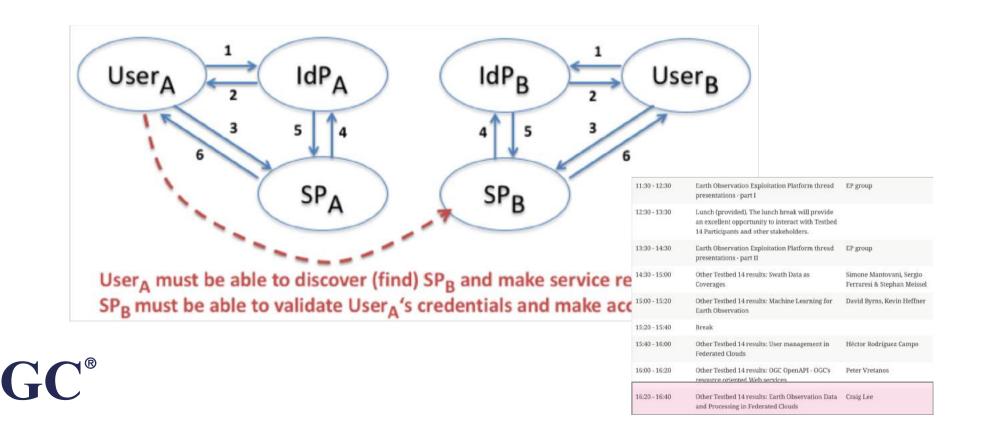
- Query nested objects
- Query that returns selected properties
- Query solid geometries
- Display in web browser

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Next Gen OGC Web Services & APIs and Complex Feature Handling: Way Forward

- Specify WFS 3.0 extensions for improved fetching

- Migrate additional resource types used in current OGC web service standards to a Next Generation architecture

- Investigate if/how GraphQL could be used to query a feature dataset

- Consider the use of CityJSON as an additional WFS 3.0 encoding for 3D city models

- Develop guidance for implementing advanced search capabilities in WFS 3.0 APIs.

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Federated Clouds: Challenge

Sharing data and computing resources in dynamic, collaborative environments that span different administrative domains with different security approaches (e.g., OpenID Connect and OAuth)

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Federated Clouds: Way Forward

- Demonstrate
  - how **federated identity can be consistently managed and used**,
  - how the **scope of attributes and authorizations** can be used to consistently manage federated environments,
  - how **resource discovery and access** can be consistently managed across administrative domains.
- Develop and use federation deployment models and evaluate implementation trade-offs.
- Develop awareness and understanding of the purpose and need for Trust Federations.

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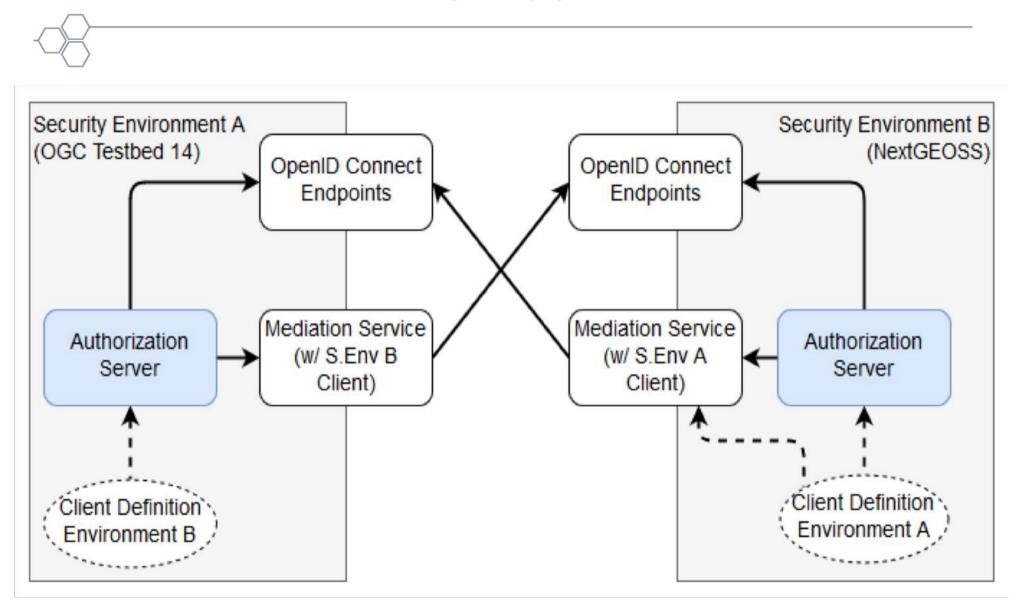
Security: Challenge

- Extend prior testbeds to address Federated Identity Mgmt at a more detailed level.

- Describe a general approach to security architectures that utilize the current state-of-the-art standards and takes into account Security Standard Candidates.

- Include best practices to integrate security into Federated Clouds and Workflows.

- Illustrate the implementation of initial steps toward realizing these practices.

11:30 - 12:30	Earth Observation Exploitation Platform thread presentations - part I	EP group
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Security: Approach

Security: Way Forward

- Further **explore fine-grained authorization**; client credentials and resource owner **grants for workflows**, and use of JSON Web Tokens to efficiently store signed and encrypted user info

- Examine ways to use OpenAPI and capabilities documents to **automate token acquisition**

- **Develop a Federation Manager** capable of managing resources and to handle **governance issues**

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Secure Workflows: Challenge
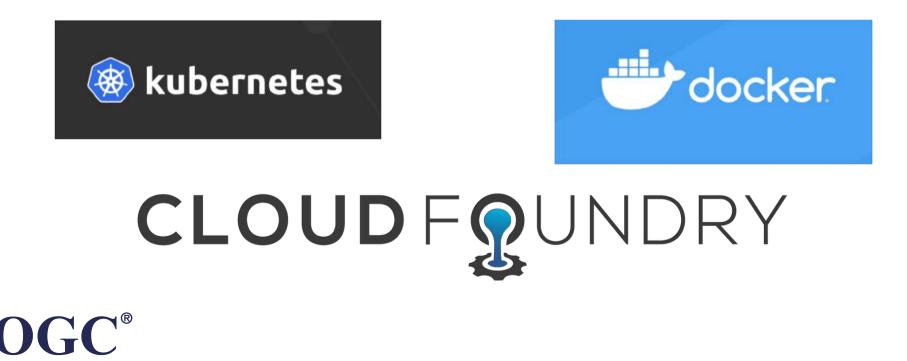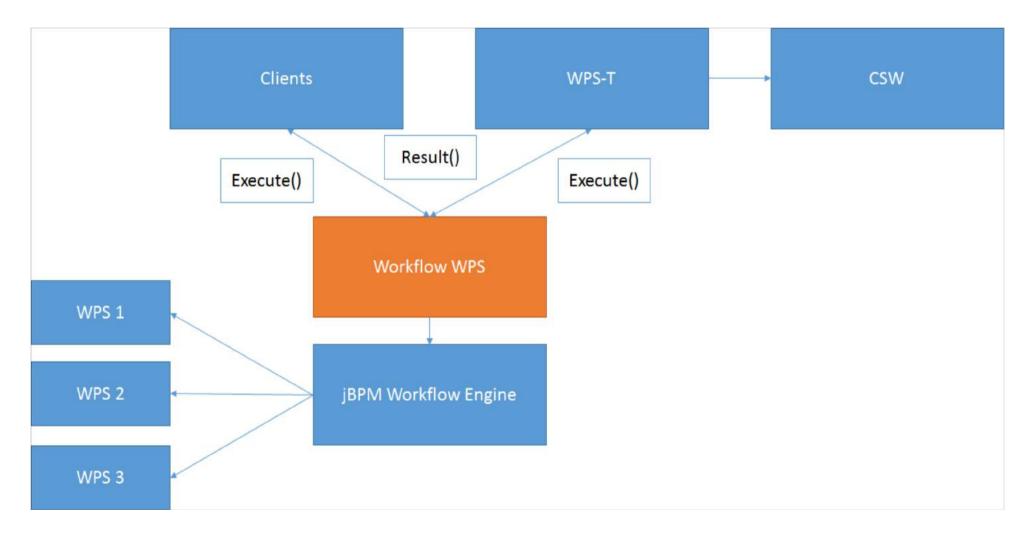
1. How does BPMN as a language relates to OGC services that focus on data -> development of best practices and guidelines

2. Investigate a **common approach** to handle **inputs** and **outputs** defined in BPMN

3. Investigate **process discovery mechanisms**

4. Investigate **security encoding aspects** in BPMN

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Platform Study

- What functionality needs to be provided as a software service?
- What is a platform function that shall be provided?
- Where are the borders between these two?

Secure Workflows: Challenge

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Secure Workflows: Way Forward

- Security, discovery of deployment profiles, and a WPS-T REST binding,
- Checking for likelihood of workflow completion success prior to execution.
- Managing the BPMN to WPS process transformation.
- More sophisticated security encoding options and removal of access.
- More complex use cases to take advantage of aspects such as parallel processing, swimlanes, decision gates and compensation events.

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Compliance and Interoperability Testing (CITE)

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Profiles Adoption: Challenge

Profiles with Extensions = Standard + Restrictions + Other stuff

CAT 2.0 + DGIWG Rules

- Verify that the response indicates support for 'English' for queriables and returnables
- Verify that the XML response indicates support for csw:Record and gmd:MD_Metadata
- ...

How can we verify this and encourage implementations?

Not always straightforward to adopt by implementers

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Profiles Adoption: Approach

DGIWG Catalogue Service for the Web 2.0

Development of an Executable Test (ETS)

Provided feedback to the draft standard

Advanced Reference Implementation

Bi-product now we have also new reference implementation for CAT 2.0

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Profiles Adoption: Way Forward

Parallelize the work of developing the standard, developing an executable test suite, and early implementations.

2018 TC-Discuss #1 Hot Topic

@ [TC-Discuss] required impleme... Archive - OGC 42 »
I am also in favour of requiring multiple (three
seems reasonable with at least one independen...

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Testing Resource Oriented Services: Challenge

- OGC is/will be developing more Representational State Transfer (REST) Application Program Interface (API) (e.g. WFS 3.0)

- No REST tests existed before Testbed 14

- No Capabilities, where to start?

- You can navigate from one resources to other resources - and can create infinite loops

- No XML, JSON - Schema?

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Testing Resource Oriented Services: Approach

WFS 3.0 Executable Test Suite

- Use OpenAPI as a starting point

- Picked one output format to test responses (JSON)

- Make sure the test is configure properly to select some features to test, not all of them (time)

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Testing Resource Oriented Services: Way Forward

For new tests:

- Create an OpenAPI conformance class or make it part of the core
- Core must be the simplest minimum good to have rules
- Mandate a default encoding (e.g. GeoJSON)

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Testing Clients: Challenge

- We had one test WMS 1.3

- Need a better architecture

- Add Security component

- **Use Case 1** is to verify that the secure client can anonymously connect to the secure server using HTTPS and issue valid requests.

- **Use Case 2** is similar to Case 1, but the secure client must provide authentication to the server.

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Testing Resource Oriented Services: Approach

Secure Client Test

WMS 1.1.1, WMS 1.3.0, and OWS Common

9. → SAML Authentication Request
10. ← Basic Authentication Challenge
11. → Username/Password Response
12. ← SAML Authentication Response

Identity Provider

1. → Public GetCapabilities Request
4. ← Capabilities Document

2. → Public GetCapabilites Request
3. ← Capabilities Document

5. → Secure GetCapabilities Request
8. ←→   SAML Authentication Request
13. ←→   SAML Authentication Response
16. ← Capabilities Document

6. → Secure Get Capabilities Request
7. ← SAML Authentication Request
14. → SAML Authentication Response
15. ← GetCapabilities Document

Client: ArcGIS Desktop
SAML: User Agent

Team Engine
Proxy: User Agent, SP & IDP Communications

Web Map Service (WMS) Version 1.1.1
SAML: Service Provider (SP)

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Testing Resource Oriented Services: Way Forward

For new tests:

- Consider – adding conformance classes for clients testing

- Consider reusing the client security conformance classes in future tests

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Testbed-15 Topics

- Machine Learning
- Delta Updates
- Data Centric Security
- Federated Cloud Analytics
- Portrayal
- Earth Observation Process and Application Discovery

bit.ly/Testbed-15

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Thank you!

Testbed 14:
https://www.opengeospatial.org/projects/initiatives/testbed14

Testbed 15:
https://www.opengeospatial.org/projects/initiatives/testbed15

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