



Open
Geospatial
Consortium

OGC Standards

An overview

2022-12-15 | Scott Simmons, Chief Standards Officer, OGC



Agenda

- About the OGC
- Part 1: OGC's approach to standardization
- Part 2: Introduction to OGC Standards
- Part 3: The Standards universe beyond OGC
- Part 4: Deploying standardized solutions



What is OGC?

A hub for thought leadership, innovation, and standards for all things related to location

Our Vision

Building the future of location with community and technology for the good of society

Our Mission

Make location information Findable, Accessible, Interoperable, and Reusable (FAIR)

Our Approach

A proven collaborative and agile process combining consensus-based standards, innovation project, and partnership building

Who Are Our Members?

Commercial

Business Development

Global: Brand Exposure

Competitive Technical Advantage

Funding for Innovation

Government

Innovation & Market Support

International Partnerships

Trusted Advice

Operational Policy

Support & Certification

Research & Academia

Applied Research Partners

International Collaboration

Funding for Innovation

Citations



WITH THIS TREATY, WE ARE PROUD TO
ANNOUNCE THE CREATION OF THE WORLD'S
FIRST *SLOPED* INTERNATIONAL BORDER!



IF I'M EVER PUT IN CHARGE OF A COUNTRY, I'M GOING
TO SPEND ALL MY TIME TRYING TO THINK OF NEW
WAYS TO MAKE LIFE A NIGHTMARE FOR GIS PEOPLE.

OGC's approach to standardization

An aerial photograph of a vast, snow-covered mountain range. The terrain is rugged with deep valleys and ridges, all blanketed in white snow. A prominent river valley winds through the center of the range. The sky is a clear, deep blue, with scattered white clouds and a thin layer of haze near the horizon. The overall scene is serene and expansive.

An aerial photograph of a vast, snow-covered mountain range, likely the Rocky Mountains, under a clear blue sky. The terrain is rugged and covered in patches of snow and dark rock. The sky is a deep, clear blue, and there are some wispy clouds near the horizon.

**The nice thing about standards is that
you have so many to choose from**
- Andrew Tanenbaum



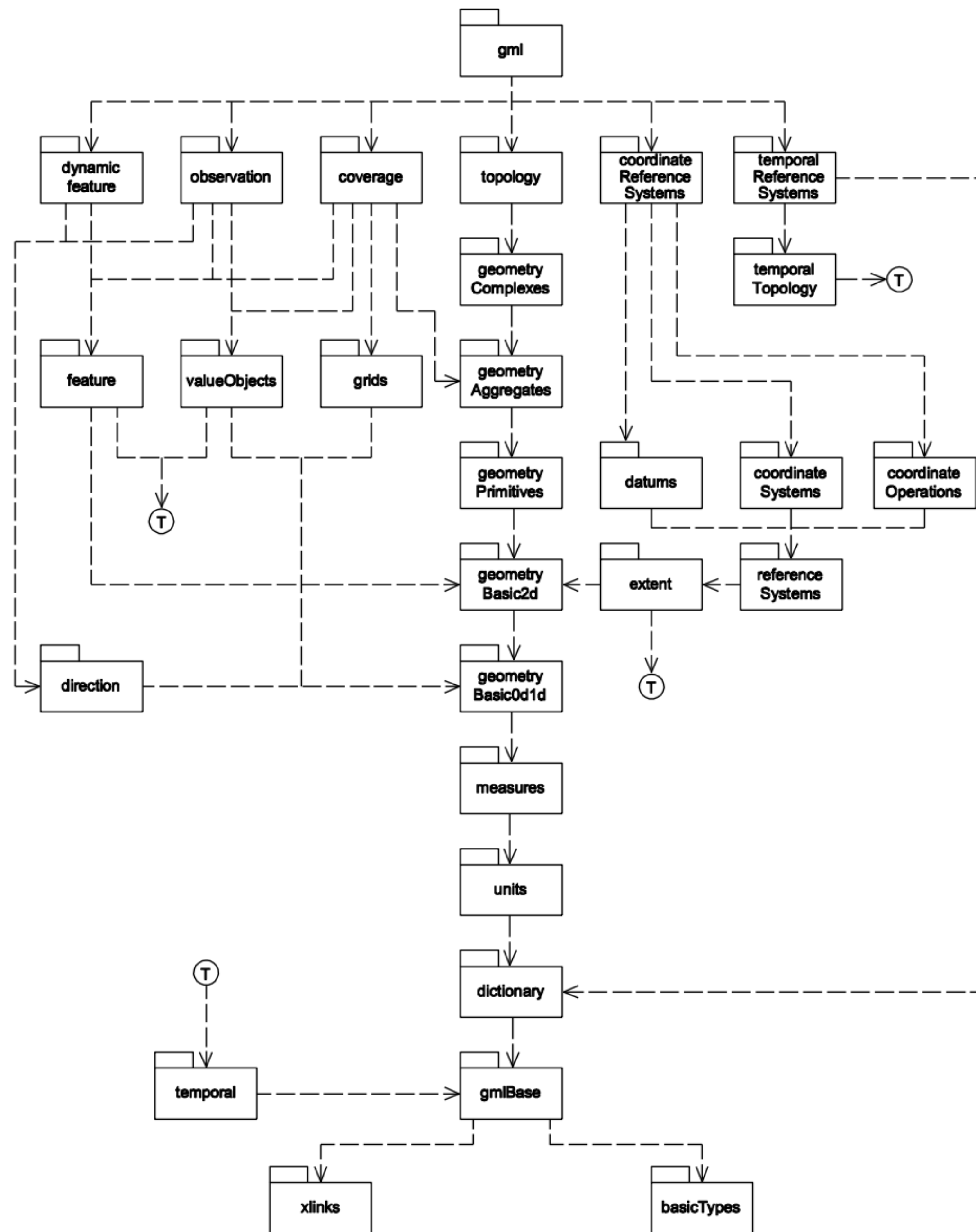


Figure 82 — Schema dependencies



Discovery

CSW	OpenSearch Geo	Catalogue extension for ebRIM	GeoSPARQL	OpenSearch for EO	Ordering Services for EO
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PubSub, Syndication, and Context

PubSub	GeoRSS	OWS Context
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Containers

CDB	HDF5
GeoPackage	netCDF

Services and APIs

OGC APIs	WMS (Web Map Service)	WMTS (Web Map Tile Service)	3DPS (3D Portrayal Service)	I3S (Indexed 3D Scene Layers)	GeoAPI	TJS (Table Joining Service)
OpenMI	WFS (Web Feature Service)	WCS (Web Coverage Service)	OWS Common	3D Tiles	Web Services Security	WCPS (Web Coverage Processing)
OpenLS	WPS (Web Processing Service)					

Data Models and Encodings

Domain-specific

CityGML	CityJSON	IndoorGML	IMDF (Indoor Mapping Data Format)	LandInfra / InfraGML	PipelineML	LAS	TimeSeriesML	WaterML
ARML (Augmented Reality ML)	GUF (Geospatial User Feedback)	GeoSciML						

General

Simple Features	GML (Geography Markup Lang.)	KML	Moving Features	OpenGeoSMS	GeoXACML	Time Ontology on OWL	SLD (Styled Layer Descriptor)	O&M (Observations & Meas.)
GeoTIFF	CRS WKT	Filter Encoding	GMLJP2	2D Tile Matrix Set	Symbology Encoding	Symbology Core		

Sensors

SensorThings API	SensorML	SWE Common (Sensor Web Enablement)	SOS (Sensor Observation Service)	SPS (Sensor Planning Service)	PUCK	Semantic Sensor Network Ontology
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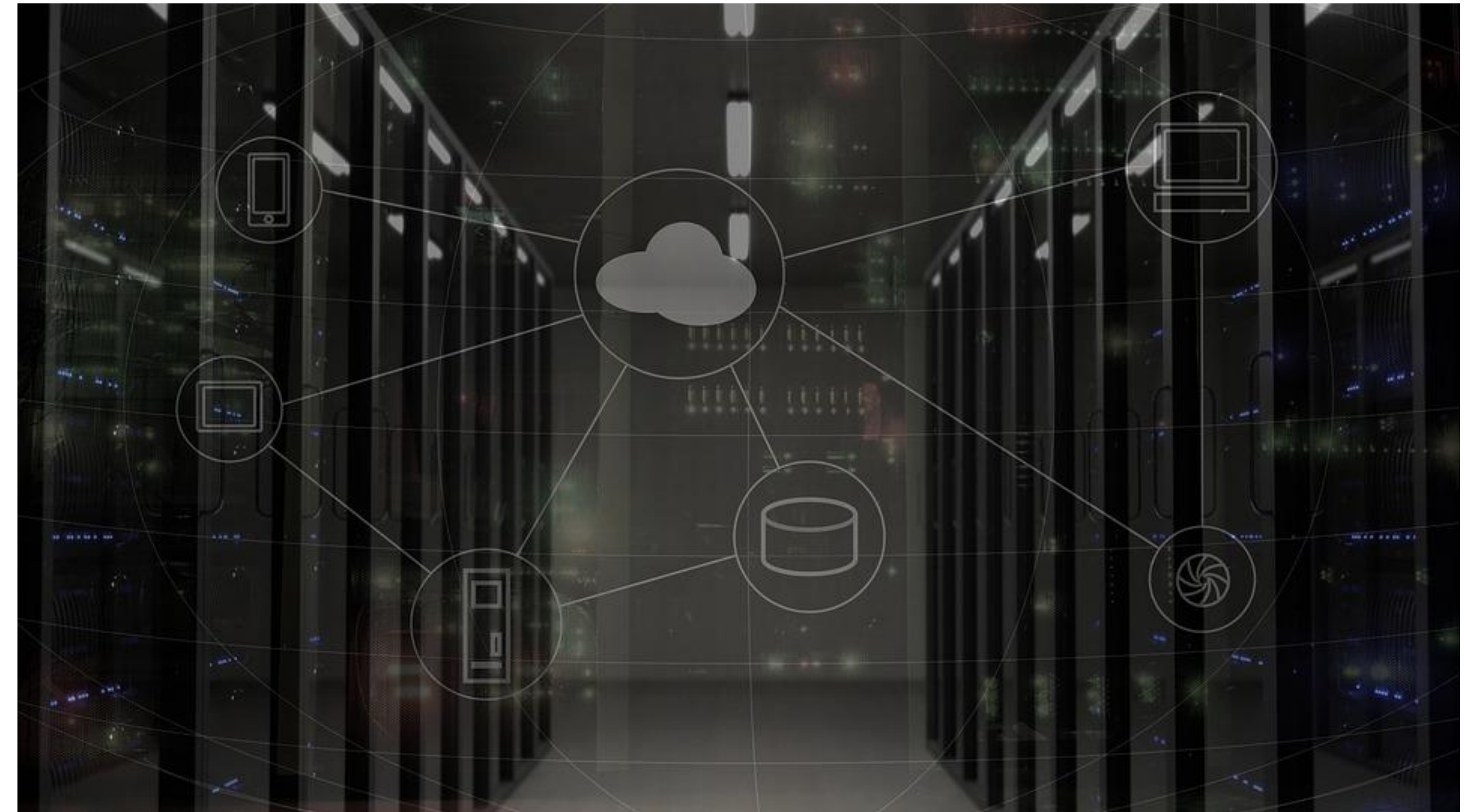
Abstract Specification





from **Data**
Interoperability...

...to **System**
interoperability



From
this...

Version	Document Title (click to download)	Document #	Type
1.3.0	OpenGIS Web Map Service (WMS) Implementation Specification	06-042	IS
	Web Map Services - Application Profile for EO Products (0.3.3)	07-063r1	BP
	Web Map Services - Application Profile for EO Products (0.2.0)	07-063	D-BP
	OpenGIS Web Map Services - Application Profile for EO Products (0.1.0)	06-093	D-DP
	DGIWG - Web Map Service 1.3 Profile - Revision (2.0)	09-102r3	BP
	DGIWG WMS 1.3 Profile and systems requirements for interoperability for use within a military environment (0.9.0)	09-102	D-BP
	OpenGIS Tiled WMS Discussion Paper (0.3.0)	07-057r2	D-DP
	OGC Best Practice for using Web Map Services (WMS) with Time-Dependent or Elevation-Dependent Data (1.0)	12-111r1	BP
1.3.0	Web Map Service	03-109r1	D-RP
1.3.0	OpenGIS Web Map Service Client (WMS) Implementation Specification	06-042	CC
1.1.1	Web Map Service	01-068r3	D-IS
1.1	Web Map Service	01-047r2	D-IS
1.0	Web Map Service	00-028	D-IS

- Info
- Tags
- Servers
- Search
- Capabilities
 - GET /
 - GET /conformance
 - GET /collections
 - GET /collections/{collectionId}
- Data
 - GET /collections/{collectionId}/it
 - GET /collections/{collectionId}/it
- Schemas

```
1 openapi: 3.0.2
2 info:
3   title: 'An API conforming to the OGC API - Features - Part 1: Core
4     standard'
5   version: 1.0.0
6   description: >-
7     This is a sample OpenAPI definition that conforms to the conformance
8     classes "Core", "GeoJSON", "HTML" and "OpenAPI 3.0" of the
9     standard "OGC API - Features - Part 1: Core".
10
11   This example is a generic OGC API Feature
12   parameters to describe all feature collec
13
14   The generic OpenAPI definition does not p
15
16   collections or the feature content. This
17
18   from accessing the feature collection res
19
20
21   There is
22
23   [another
24   example](https://app.swaggerhub.com/apis/
25   -example2/1.0.0)
26
27   that specifies each collection explicitly
28
29   contact:
30     name: Acme Corporation
31     email: info@example.org
32     url: 'http://example.org/'
33
34   license:
35     name: CC-BY 4.0 license
36     url: 'https://creativecommons.org/licenses'
```

An API conforming to the OGC API Features - Part 1: Core standard

1.0.0 OAS3

This is a sample OpenAPI definition that conforms to the conformance classes "Core", "GeoJSON", "HTML" and "OpenAPI 3.0" of the standard "OGC API - Features - Part 1: Core".

Modernization of documentation

OGC Making location count.

Execute

Execute operations

execute a process.

Submits a new job.

PATH PARAMETERS

- processId (required) string: local identifier of a process

REQUEST BODY SCHEMA: application/json

Mandatory execute request JSON

- inputs: Array of objects (input)
- outputs (required): Array of objects (output)
- mode (required) string: Enum: "sync", "async", "auto"
- response (required) string: Enum: "raw", "document"
- subscriber: object (subscriber): Optional URIs for callbacks for this job.

POST /processes/{processId}/jobs

Request samples

Payload

Content type: application/json

```
{
  "inputs": [
    + { ... }
  ],
  "outputs": [
    + { ... }
  ],
  "mode": "sync",
  "response": "raw",
  "subscriber": {
    "successUri": "http://example.com",
    "inProgressUri": "http://example.com",
    "failedUri": "http://example.com"
  }
}
```

Response samples

... to this

Standards and augmentation

OGC API - Features - Part 1: Core


Open Geospatial Consortium

Submission Date: 2019-07-11

Approval Date: 2019-09-09

Publication Date: 2019-10-14

External identifier of this OGC® document: <http://www.opengis.net/doc/IS/ogcapi-features-1/1.0>

Additional Formats (informative): 

Internal reference number of this OGC® document: 17-069r3

Version: 1.0

Category: OGC® Implementation Standard

Editors: Clemens Portele, Panagiotis (Peter) A. Vretanos, Charles Heazel

OGC API - Features - Part 1: Core

Copyright notice

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OGC API - Features - Part 2: Coordinate Reference Systems by Reference

Open Geospatial Consortium

Submission Date: 2020-07-06

Approval Date: 2020-10-27

Publication Date: 2020-11-02

External identifier of this OGC® document: <http://www.opengis.net/doc/IS/ogcapi-features-2/1.0>

Internal reference number of this OGC® document: 18-058

Version: 1.0

Category: OGC® Implementation Standard

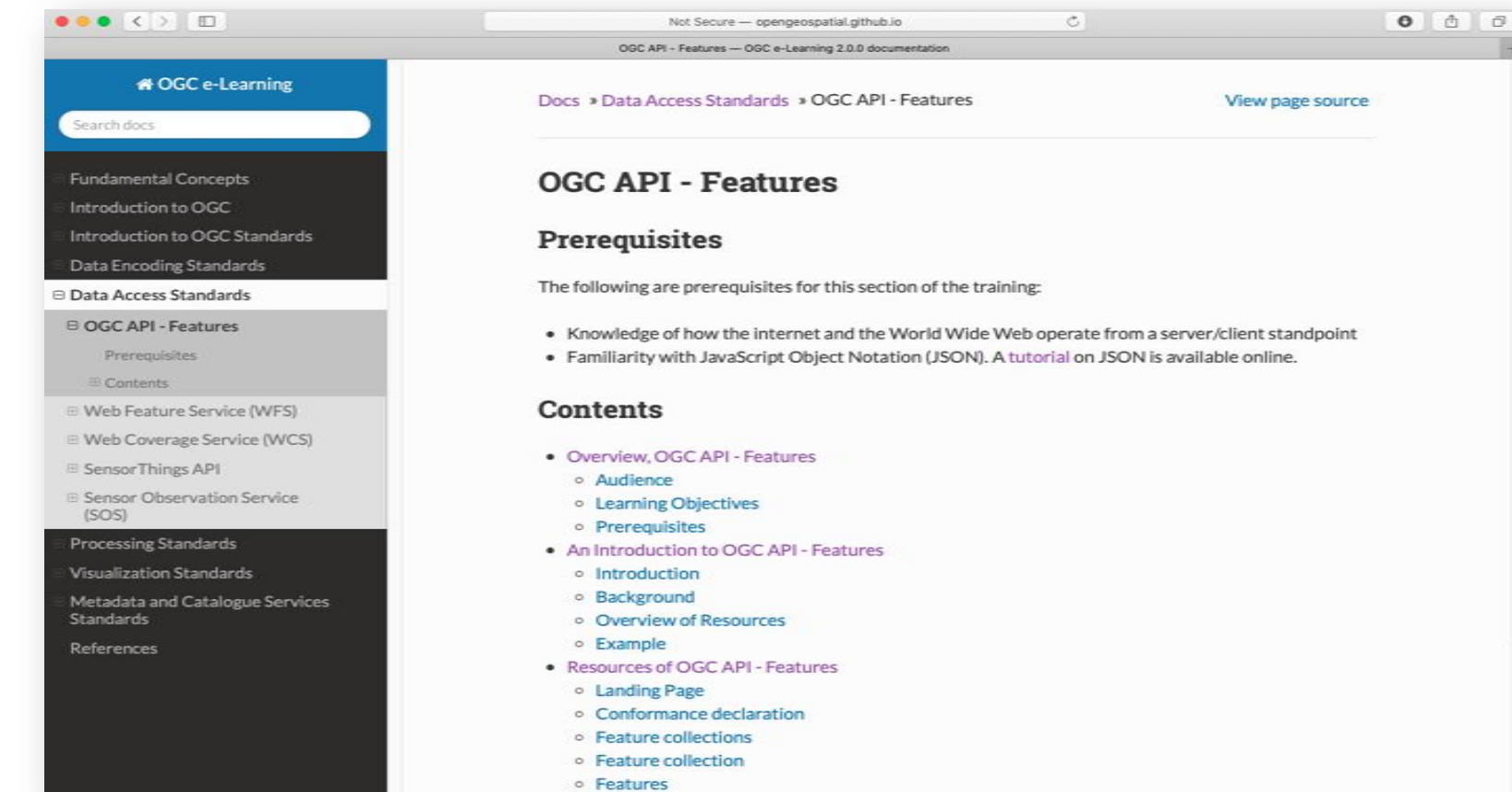
Editors: Clemens Portele, Panagiotis (Peter) A. Vretanos

OGC API - Features - Part 2: Coordinate Reference Systems by Reference

Copyright notice

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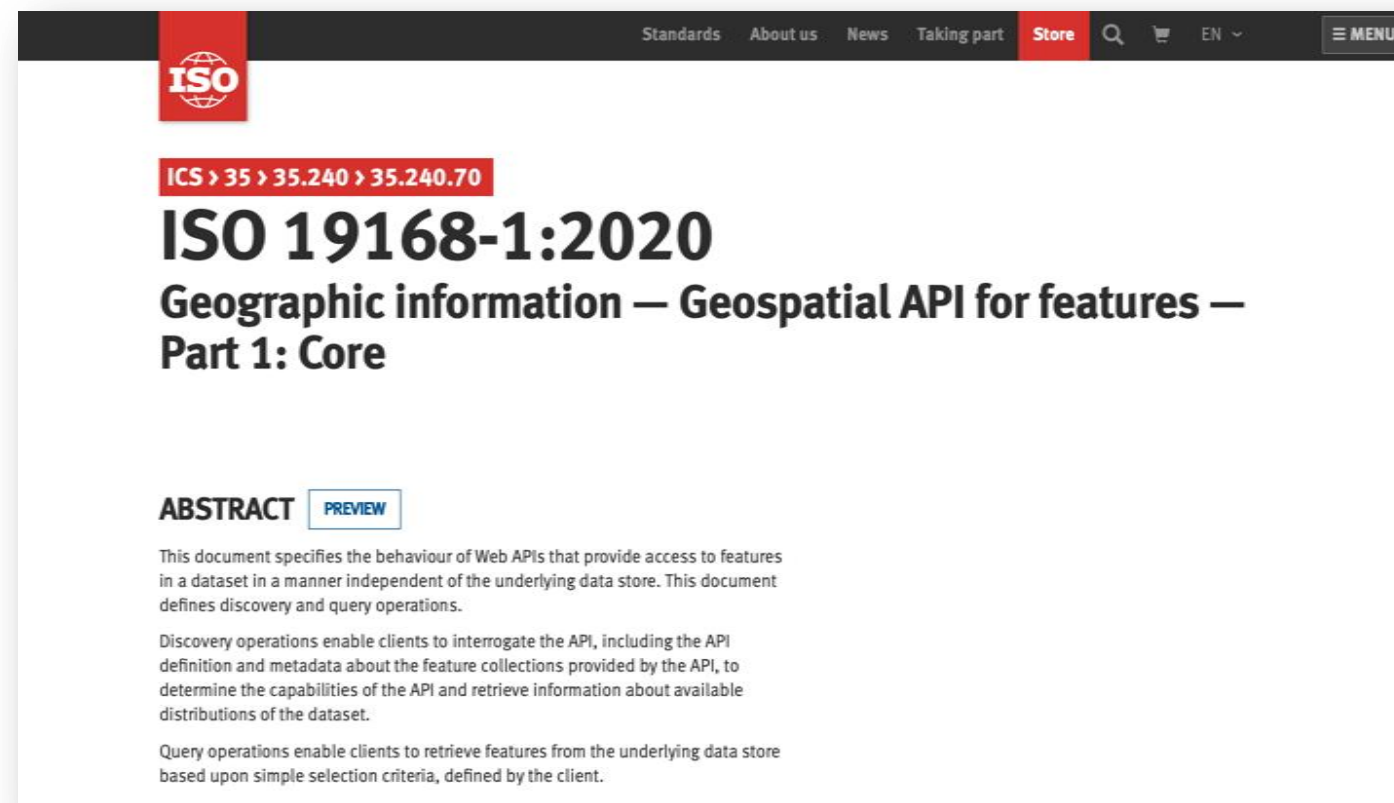
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The screenshot shows the OGC e-Learning website. The main content area is titled 'OGC API - Features' and includes a 'Prerequisites' section with the following text: 'The following are prerequisites for this section of the training:'. Below this, there are two bullet points: 'Knowledge of how the Internet and the World Wide Web operate from a server/client standpoint' and 'Familiarity with JavaScript Object Notation (JSON). A tutorial on JSON is available online.' The 'Contents' section lists several items: 'Overview, OGC API - Features' (with sub-items: Audience, Learning Objectives, Prerequisites), 'An Introduction to OGC API - Features' (with sub-items: Introduction, Background, Overview of Resources, Example), and 'Resources of OGC API - Features' (with sub-items: Landing Page, Conformance declaration, Feature collections, Feature collection, Features).

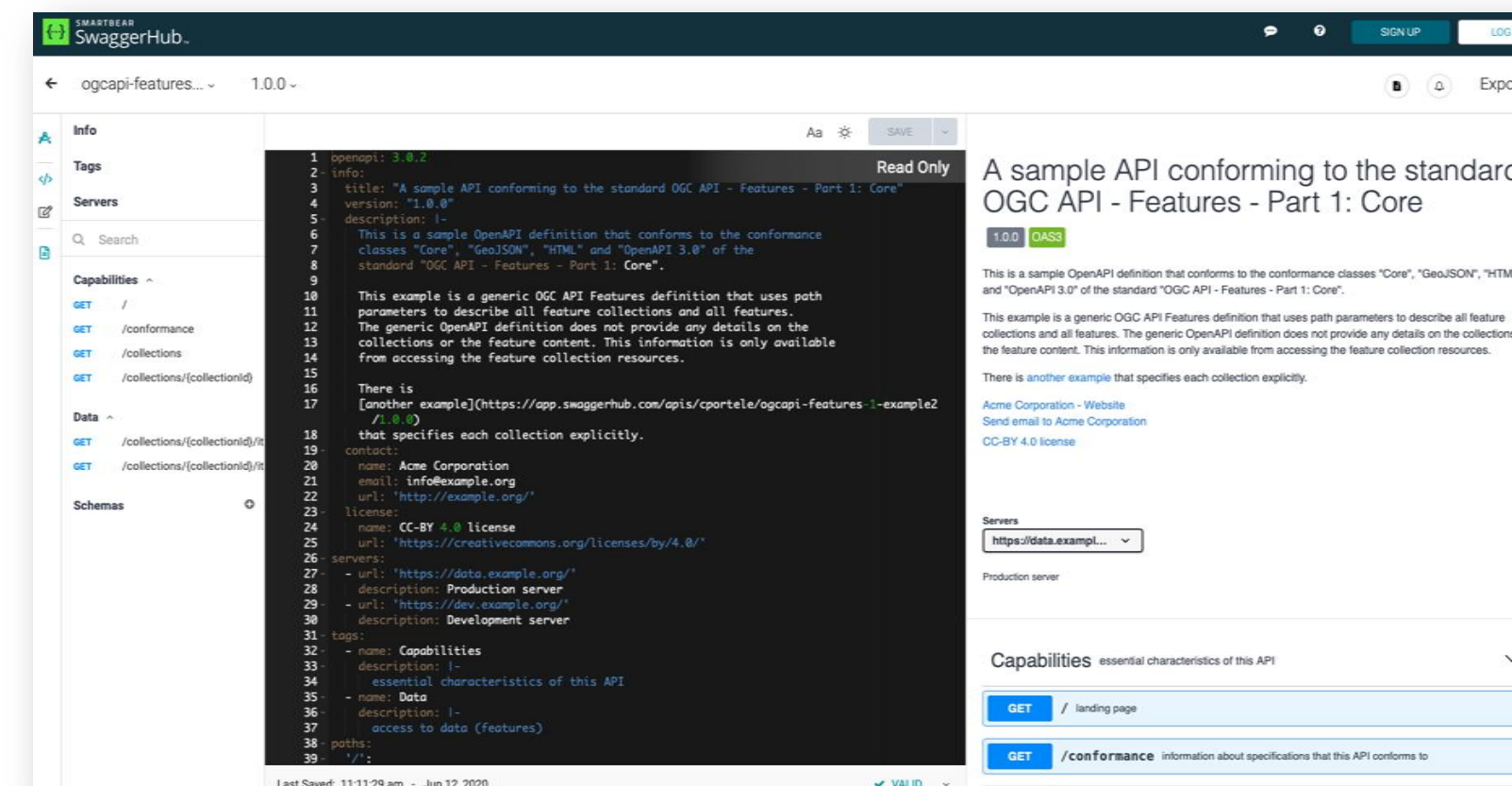
e-Learning

Core + Extensions



The screenshot shows the ISO website page for 'ISO 19168-1:2020 Geographic information — Geospatial API for features — Part 1: Core'. The page includes the ISO logo, the standard number 'ICS 35 > 35.240 > 35.240.70', and the title 'ISO 19168-1:2020 Geographic information — Geospatial API for features — Part 1: Core'. There is an 'ABSTRACT' section with a 'PREVIEW' button. The abstract text states: 'This document specifies the behaviour of Web APIs that provide access to features in a dataset in a manner independent of the underlying data store. This document defines discovery and query operations. Discovery operations enable clients to interrogate the API, including the API definition and metadata about the feature collections provided by the API, to determine the capabilities of the API and retrieve information about available distributions of the dataset. Query operations enable clients to retrieve features from the underlying data store based upon simple selection criteria, defined by the client.'

Adoption by alliance partners



The screenshot shows a SwaggerHub API definition for 'ogcapi-features-1 1.0.0'. The 'Info' section includes the title 'A sample API conforming to the standard OGC API - Features - Part 1: Core' and the version '1.0.0'. The 'Schemas' section shows a JSON definition for the API, including details about the 'Acme Corporation' and the 'CC-BY 4.0 license'. The 'Servers' section lists 'Production server' and 'Development server'. The 'Capabilities' section includes 'GET / landing page' and 'GET /conformance information about specifications that this API conforms to'.

Examples



The graphic features the OGC logo in large blue letters. Below the logo, the text reads: 'Compliance testing now available for 'OGC API - Features - Part 1: Core' standard'. The background is a dark, textured image with faint text.

Compliance Testing Tools

Work faster as a team



Joint with ISO/TC 211

SEPTEMBER, 14-16 2022 📅

ABOUT

TRACKS

SPEAKERS

FAQ

Fork me on GitHub

METADATA CODE SPRINT

🔌 *OGC API Records, STAC, ISO 19115 and JSON-FG*

TELL ME MORE

REGISTER

NOVEMBER 29- DECEMBER 1 2022 📅

ABOUT TRACKS SPEAKERS FA

Fork me on GitHub

WEB MAPPING CODE SPRINT

🗎 *OGC API - Tiles, Maps, Styles and OGC Styles & Symbology*

TELL ME MORE

REGISTER

Part 2: Introduction to OGC standards

An aerial photograph of a vast, snow-covered mountain range. A prominent river valley winds through the center of the landscape. The terrain is rugged with numerous peaks and ridges covered in white snow. Patches of dark green and brown vegetation are visible in the lower elevations. The sky is a clear, deep blue, and there are scattered white clouds, particularly in the foreground and along the valley floor.

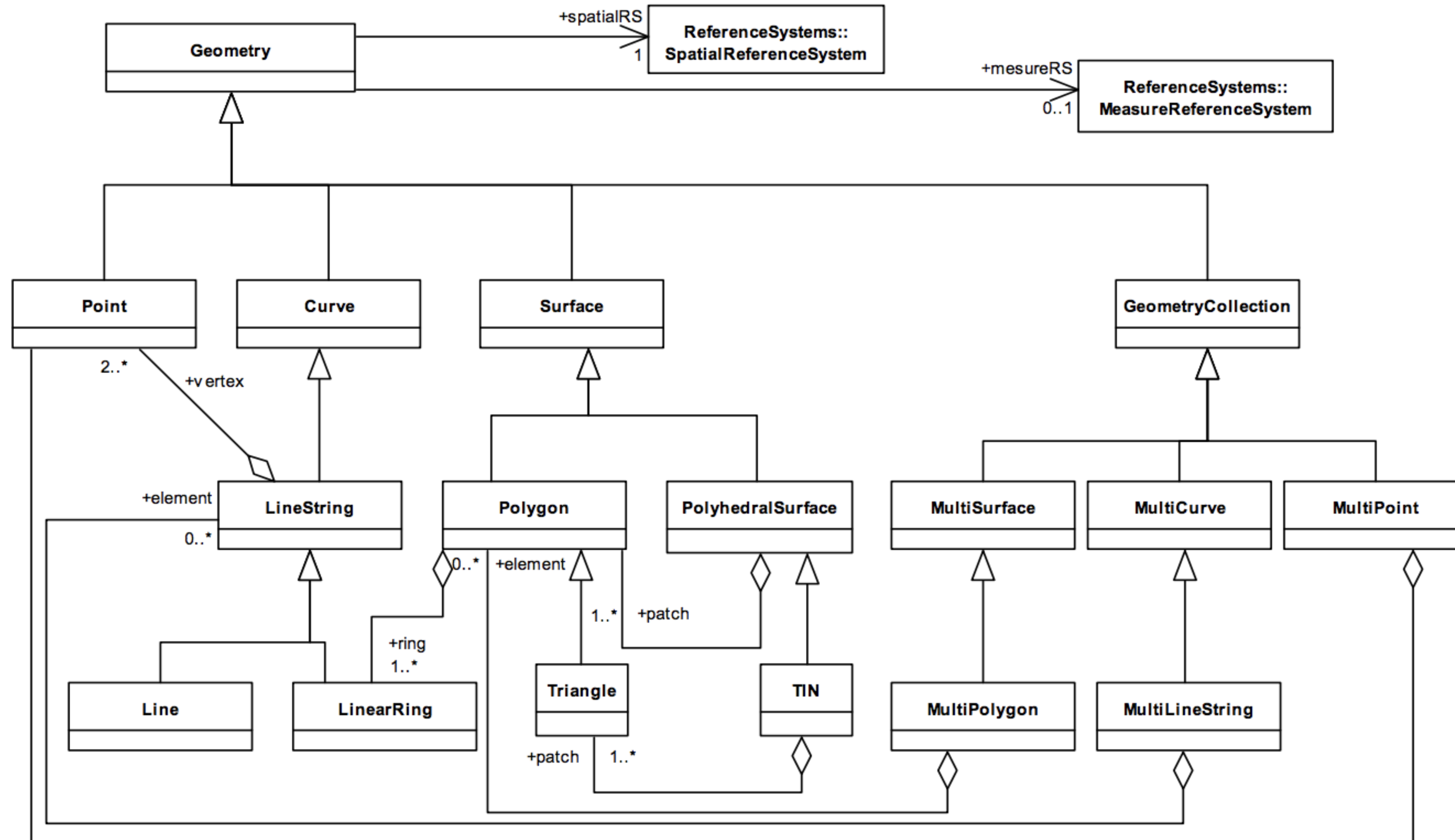
Foundational Standards

An aerial photograph of a vast, snow-covered mountain range. The terrain is rugged and covered in white snow, with a prominent river valley winding through the center. The sky is a clear, deep blue, and there are some wispy clouds near the horizon. The overall scene is bright and expansive.

Build on top of these

- Simple Features – describe simple and not-so-simple geometric primitives for feature data
- Well Known Text Coordinate Reference System (WKT CRS) – complete definition of a coordinate reference system including geodetic and transformation parameters
- Coverage Implementation Schema (CIS) – another multidimensional data store for gridded data; grids may be irregular in all dimensions
- Discrete Global Grid System (DGGS) nested multi-scale tessellation of the globe

Simple Features



Well Known Text Coordinate Reference System (WKT CRS)

Example of WKT describing a derived geodetic CRS

EXAMPLE Derived geodetic CRS with rotated pole

```
GEODCRS["ETRS89 Lambert Azimuthal Equal Area CRS",
  BASEGEODCRS["WGS 84",
    DATUM["WGS 84",
      ELLIPSOID["WGS 84",6378137,298.2572236,LENGTHUNIT["metre",1.0]]],
    DERIVINGCONVERSION["Atlantic pole",
      METHOD["Pole rotation",ID["Authority",1234]],
      PARAMETER["Latitude of rotated pole",52.0,
        ANGLEUNIT["degree",0.0174532925199433]],
      PARAMETER["Longitude of rotated pole",-30.0,
        ANGLEUNIT["degree",0.0174532925199433]],
      PARAMETER["Axis rotation",-25.0,
        ANGLEUNIT["degree",0.0174532925199433]]],
    CS[ellipsoidal,2],
    AXIS["latitude",north,ORDER[1]],
    AXIS["longitude",east,ORDER[2]],
    ANGLEUNIT["degree",0.0174532925199433]]]
```




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Geospatial
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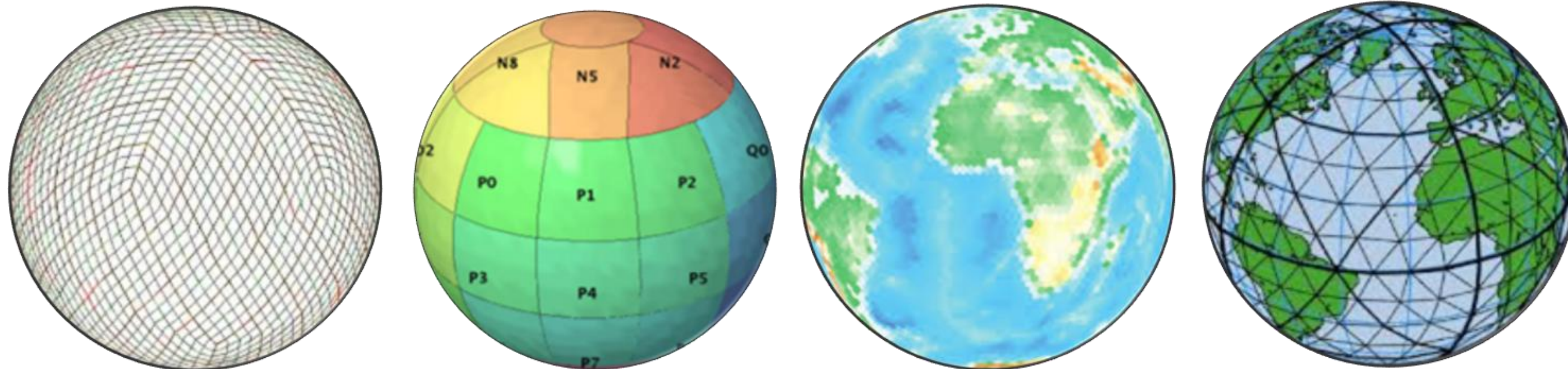


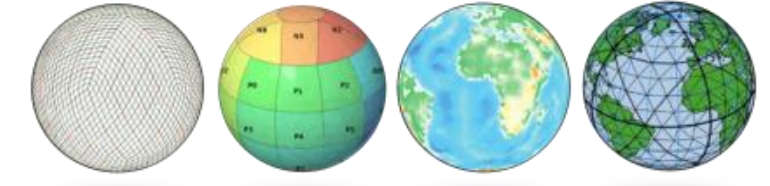
Discrete Global Grid Systems

- “...a *spatial reference system* that uses a *hierarchical tessellation of cells* to partition and *address the globe*. DGGS are characterized by the properties of their cell structure, geo-encoding, quantization strategy and associated mathematical functions.”

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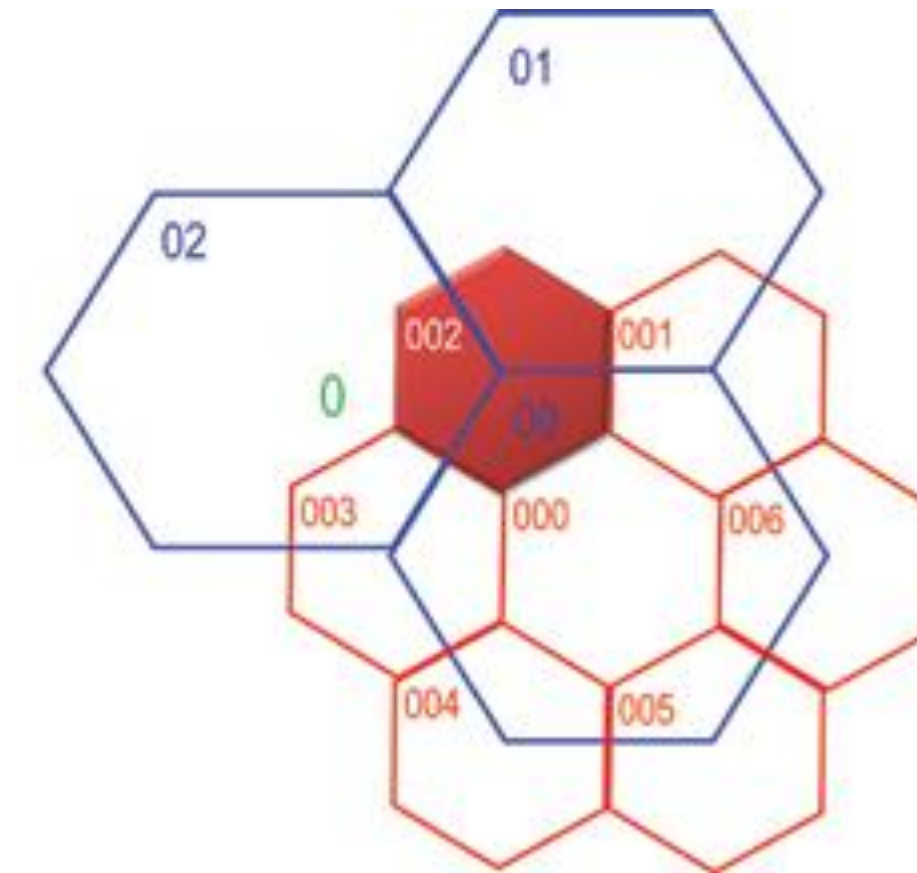
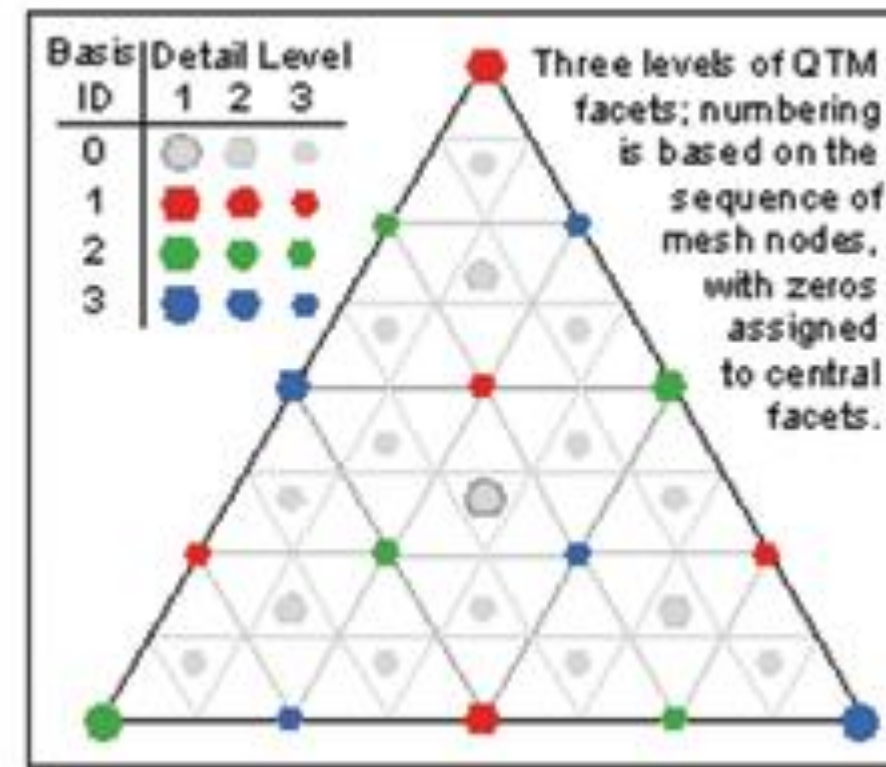
- OGC DGGS Candidate Standard





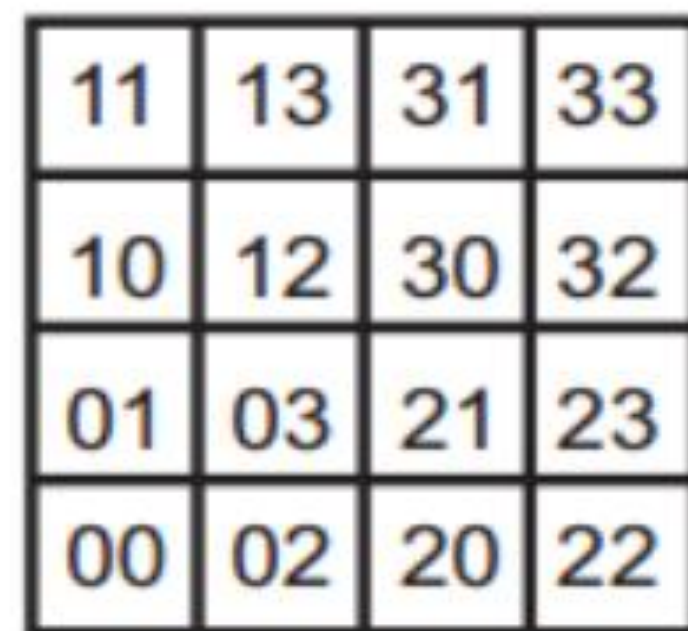
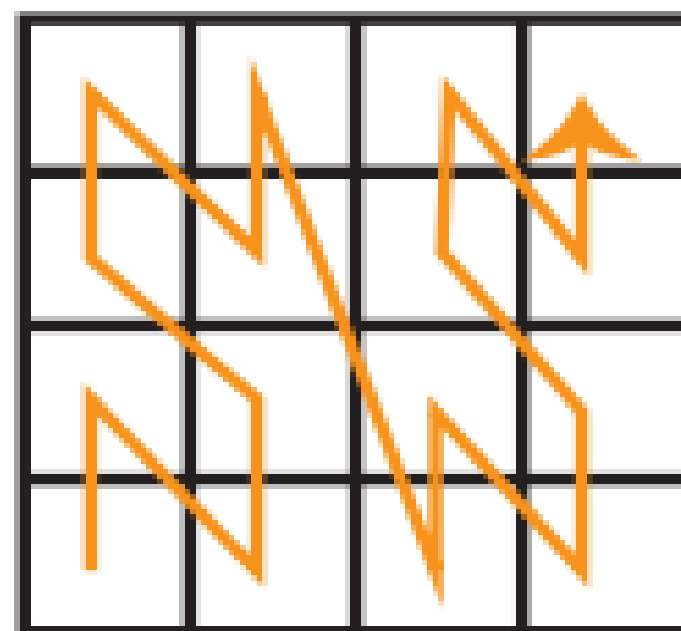
Standardising Discrete Global Grid Systems

Different Cell Shapes



Square = Familiar **Triangular = Fast** **Hexagonal = Fineness of Fit**
Unique Cell Indices

- *Hierarchy-based, Space-filling Curve, Axes-based or Encoded Address*



nD Spatial Analyses



1D Array Processes



Acquiring Data

An aerial photograph of a vast, snow-covered mountain range. A prominent river valley winds through the center of the landscape, with a road or railway line following its course. The terrain is rugged, with numerous peaks and ridges covered in snow. The sky is a clear, deep blue, and there are scattered white clouds, particularly in the lower right and middle ground. The overall scene is one of a high-altitude, winter environment.

Mostly about sensors

- Observations and Measurements (O&M) – self explanatory: defines a standardized way to store observed data
- Copyright © 2018 Open Source Smart Consulting Sensor Web Enablement (SWE) – a suite of standards to task, control, and collect data from sensors of all types; heavily used in remote sensing
- SensorThings API – a very lightweight API for Internet of Things-connected sensors; defines sensing and tasking

Observations and Measurements (O&M)

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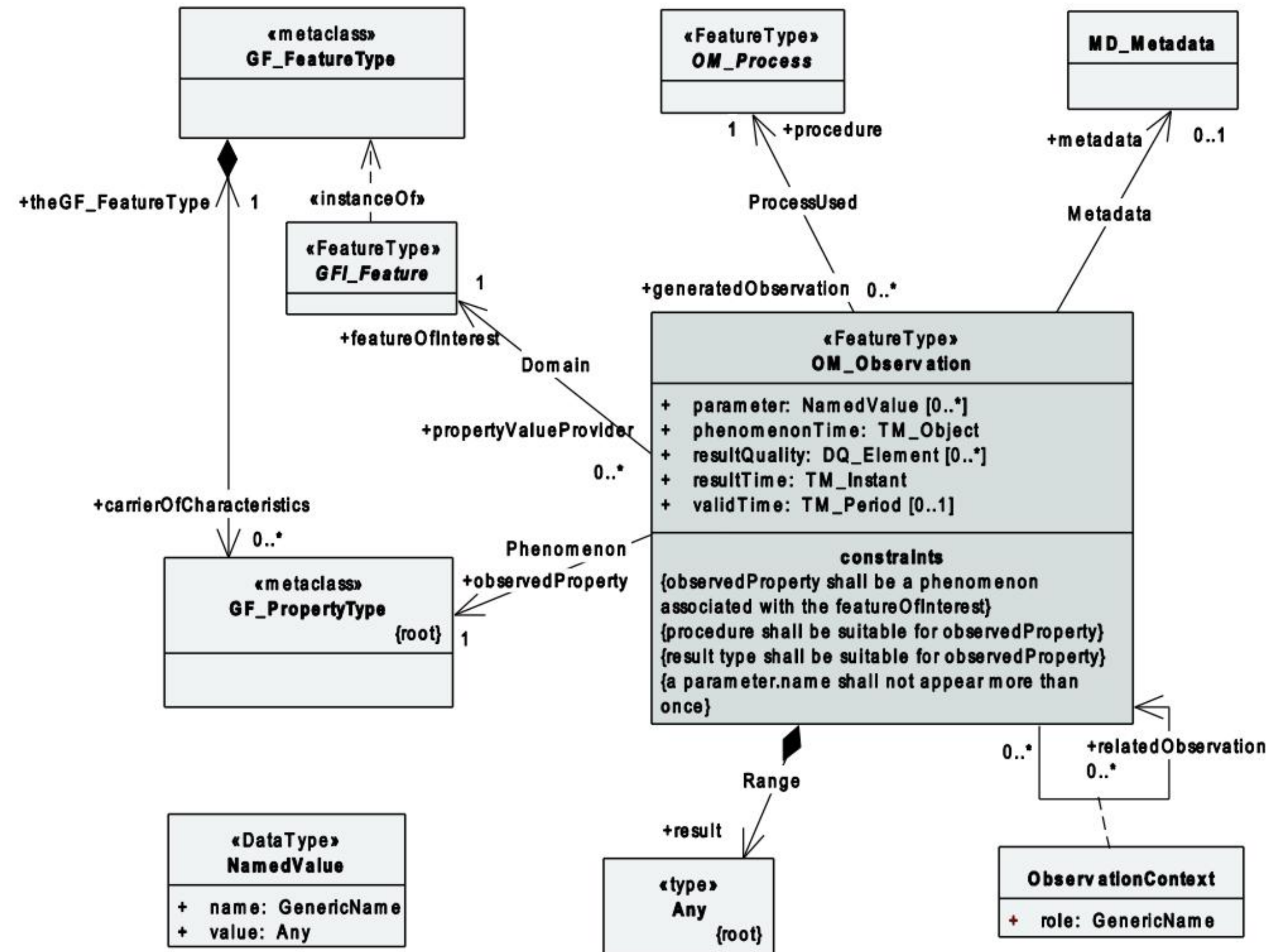


Figure 2 — The basic Observation type

OGC Sensor Web Enablement

- Sensors connected to and discoverable on the Web
- Sensors have position & generate observations
- Sensor descriptions available
- Services to task and access sensors
- Local, regional, national scalability
- Enabling the Enterprise



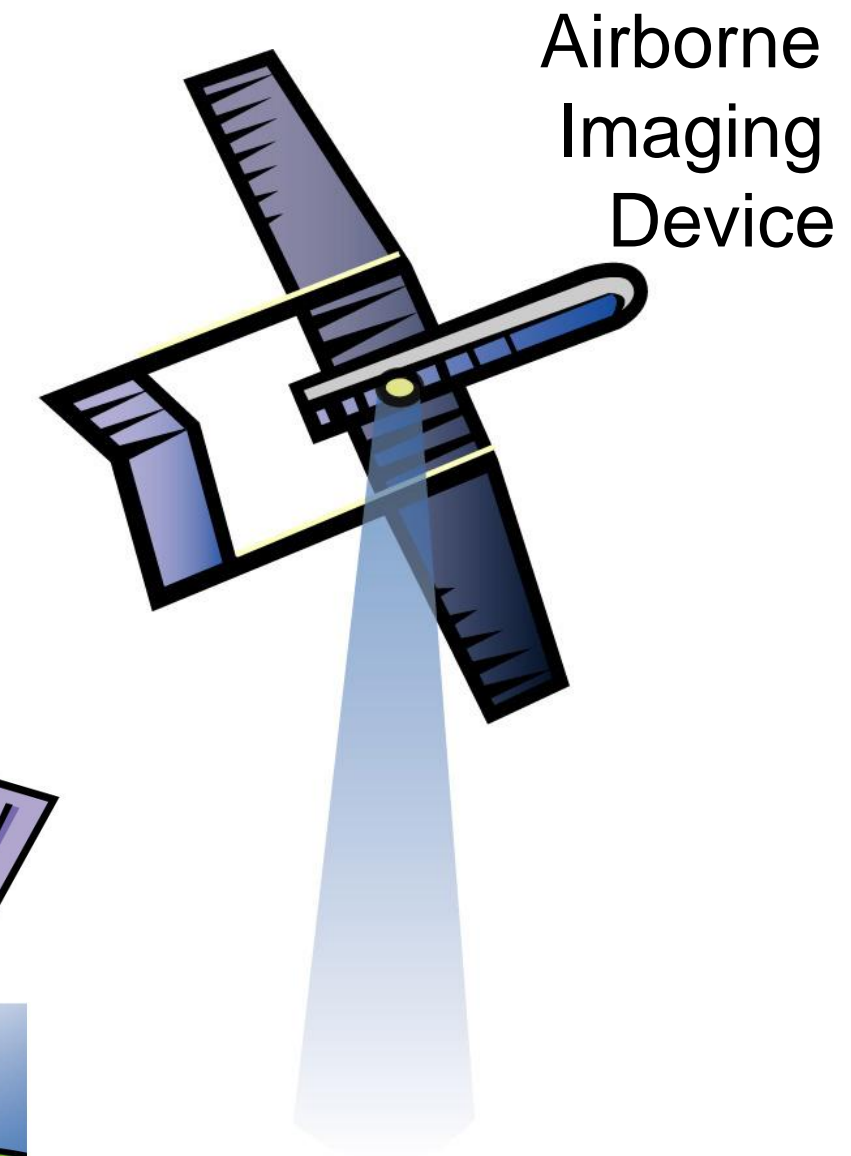
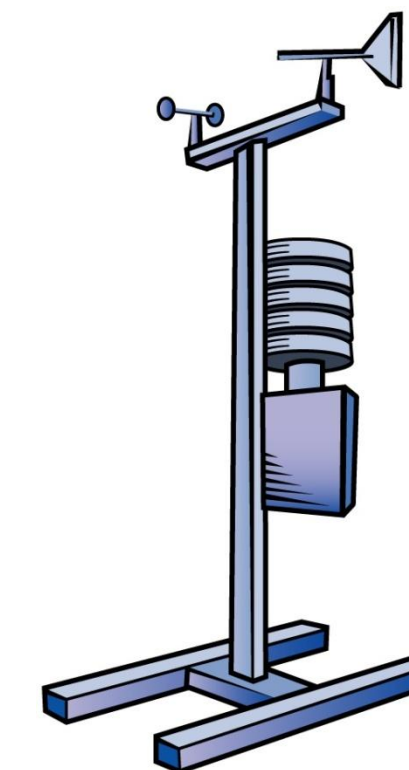
Vehicles
As Sensor Probe



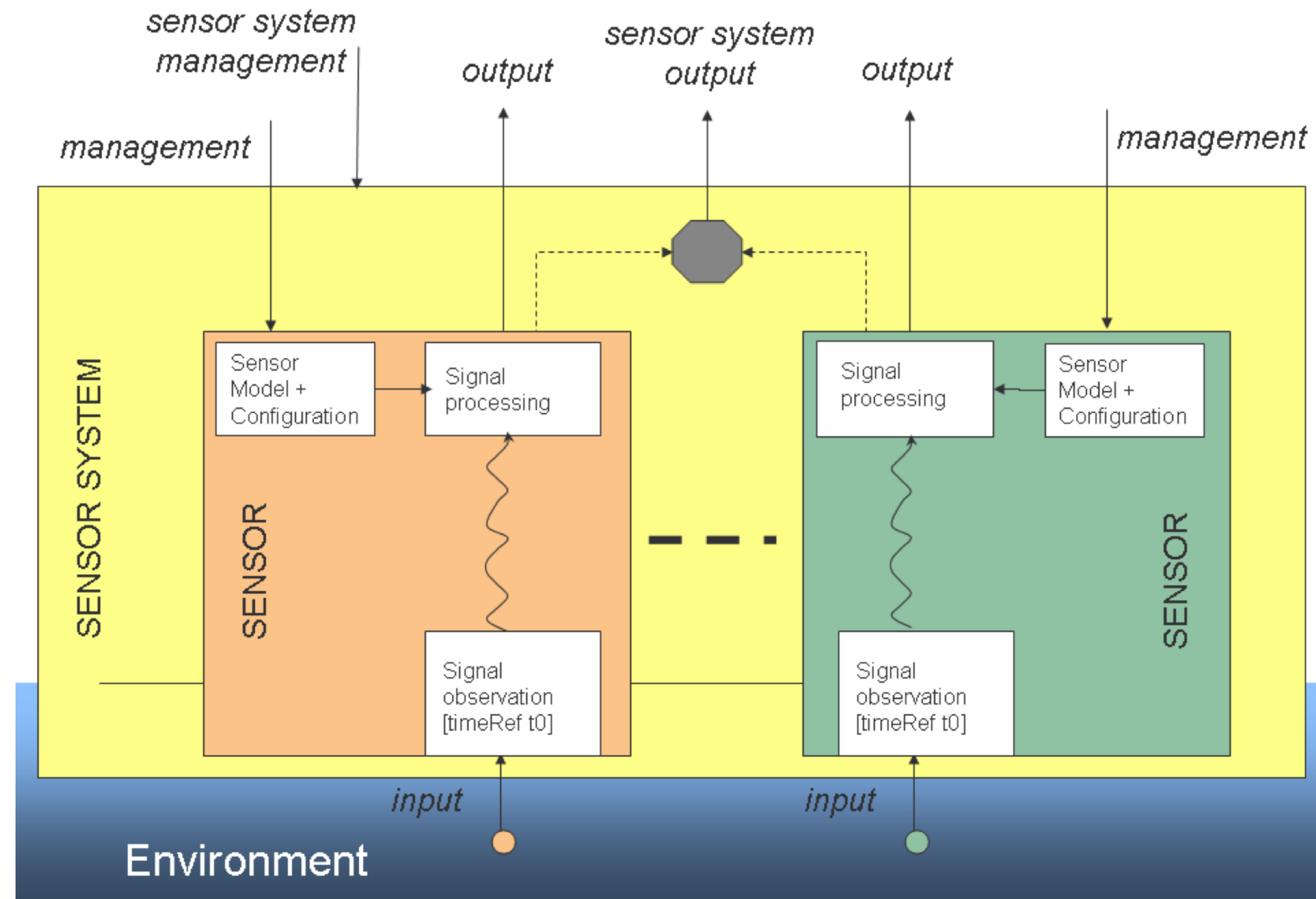
Satellite-borne
Imaging Device



Environmental
Monitor



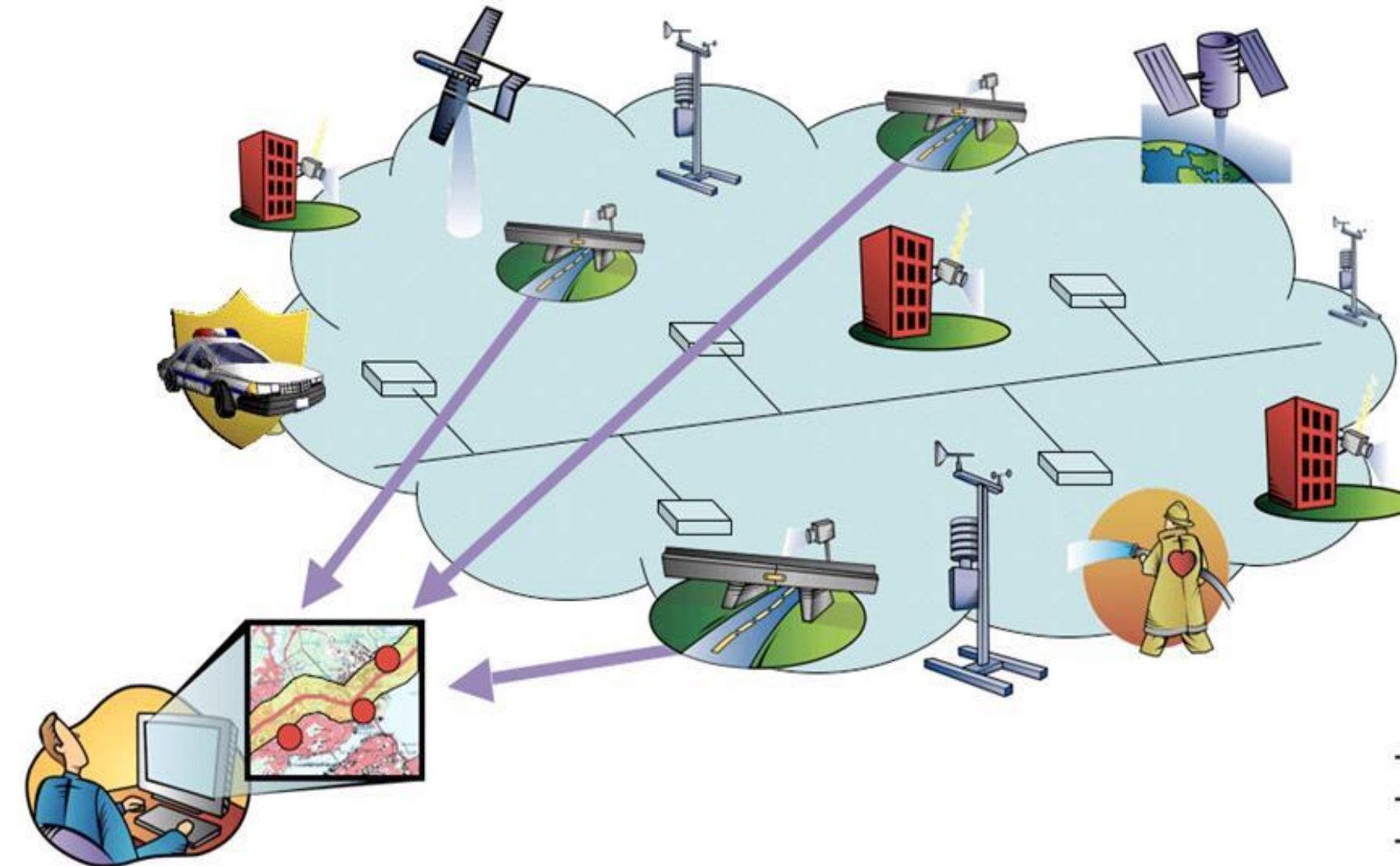
Model of a Sensor System



Sensor Web Enablement Architecture, OGC document 06-021r4
http://portal.opengeospatial.org/files/?artifact_id=29405

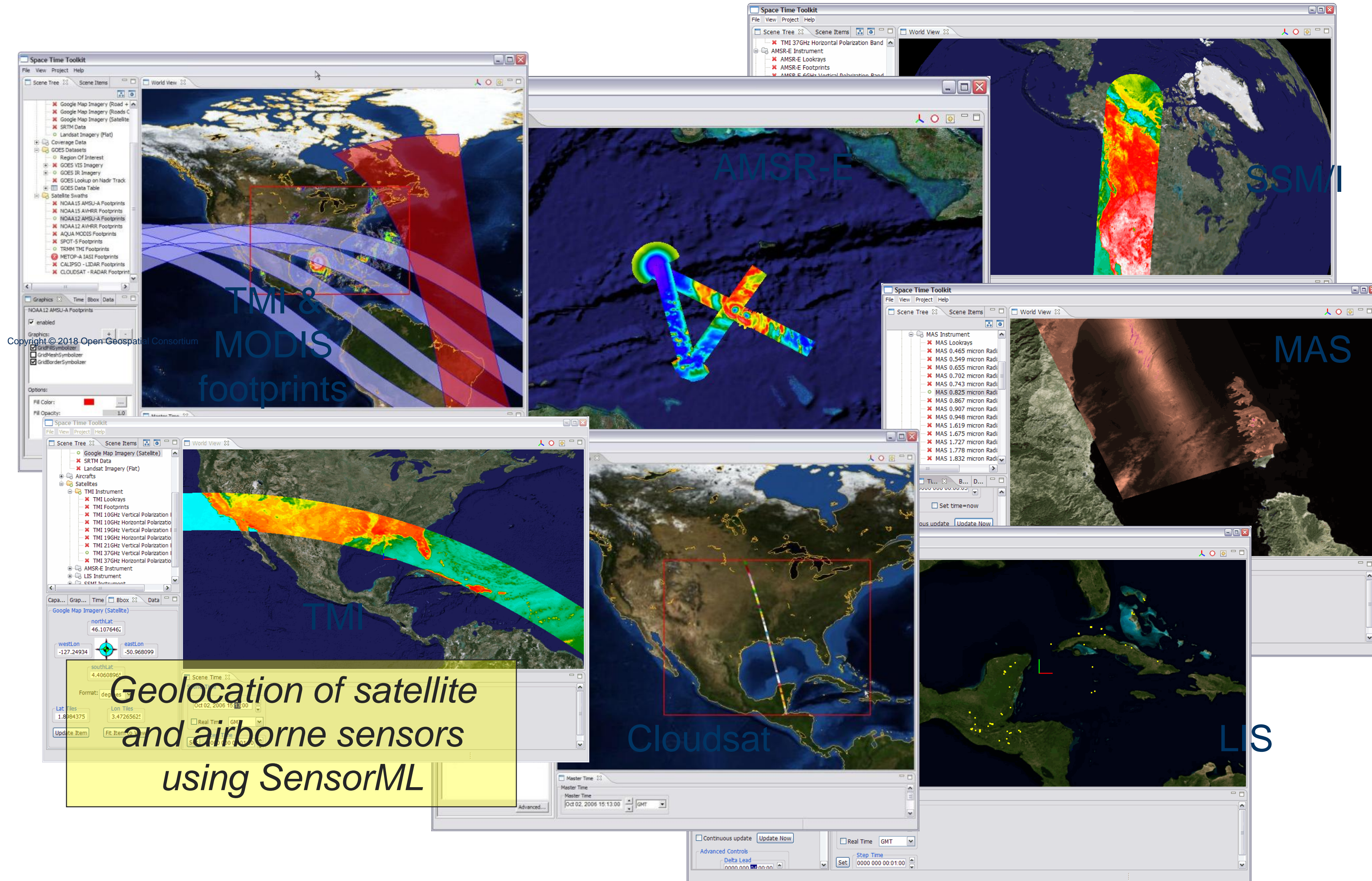
SWE Information Models and Schema

- SWE Information Models and Encodings
 - Sensor Model Language (SensorML)
 - Observations and Measurements (O&M)
 - SWE Common
- SWE Web Services
 - Sensor Observation Service (SOS)
 - Sensor Planning Service (SPS)
 - Sensor Alert Service (SAS)
 - PUCK



SWE Standards are deployed in operational systems – TRL Level 9

On-demand Geolocation using SensorML





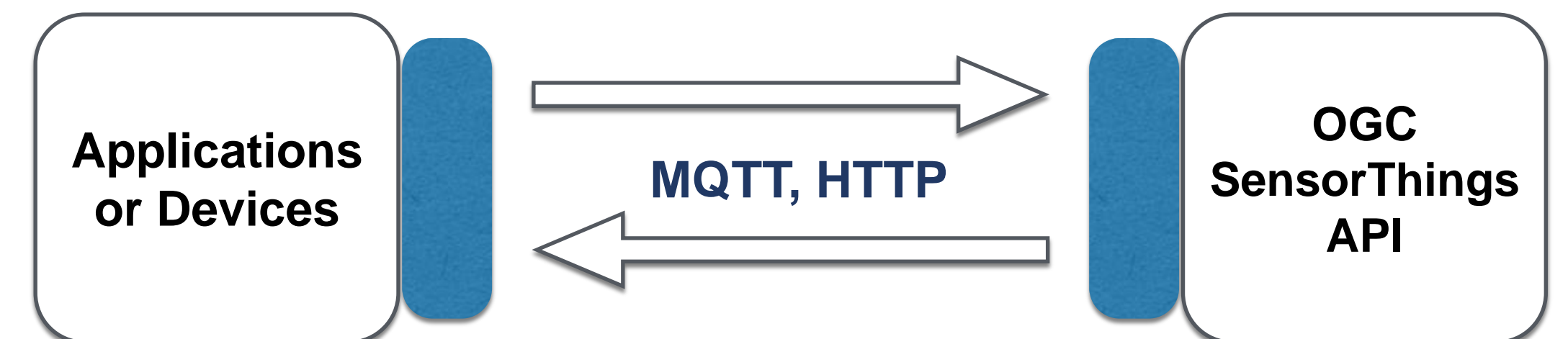
Debris Flow Prevention Platform、APP



Based on OGC Web Services and Sensor Web Enablement Standards

OGC SensorThings API

- Open, geospatial-enabled API to IoT devices, data, apps
 - Part of OGC Sensor Web Enablement Standards, with operational deployments for over a decade
 - Open Geospatial Consortium Standard
 - ITU Technical Specification D3.2

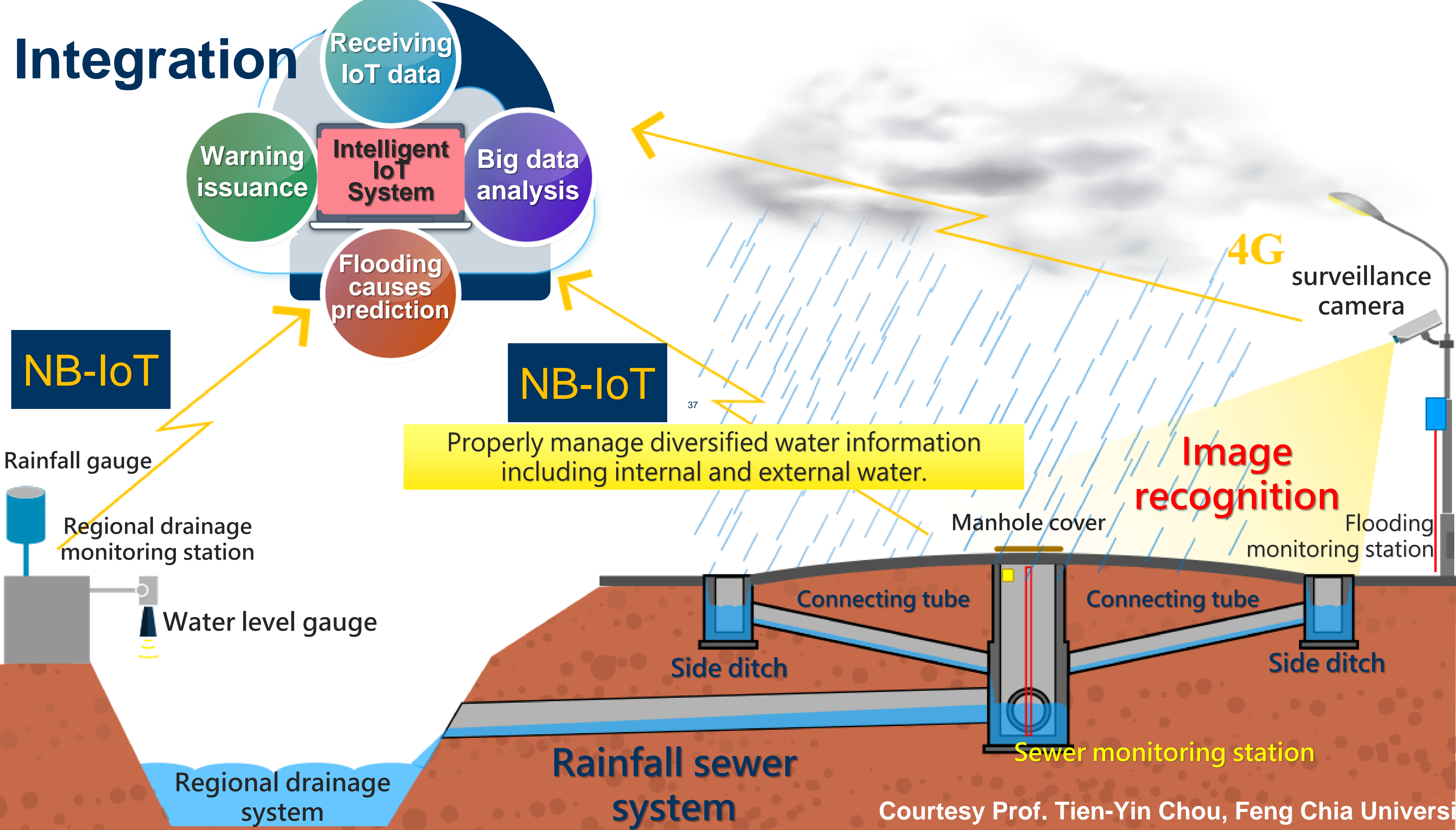


- Provides these functions
 - Sensor data management
 - Sensor data analytics
 - Command and Control
 - Event Detection and Notification

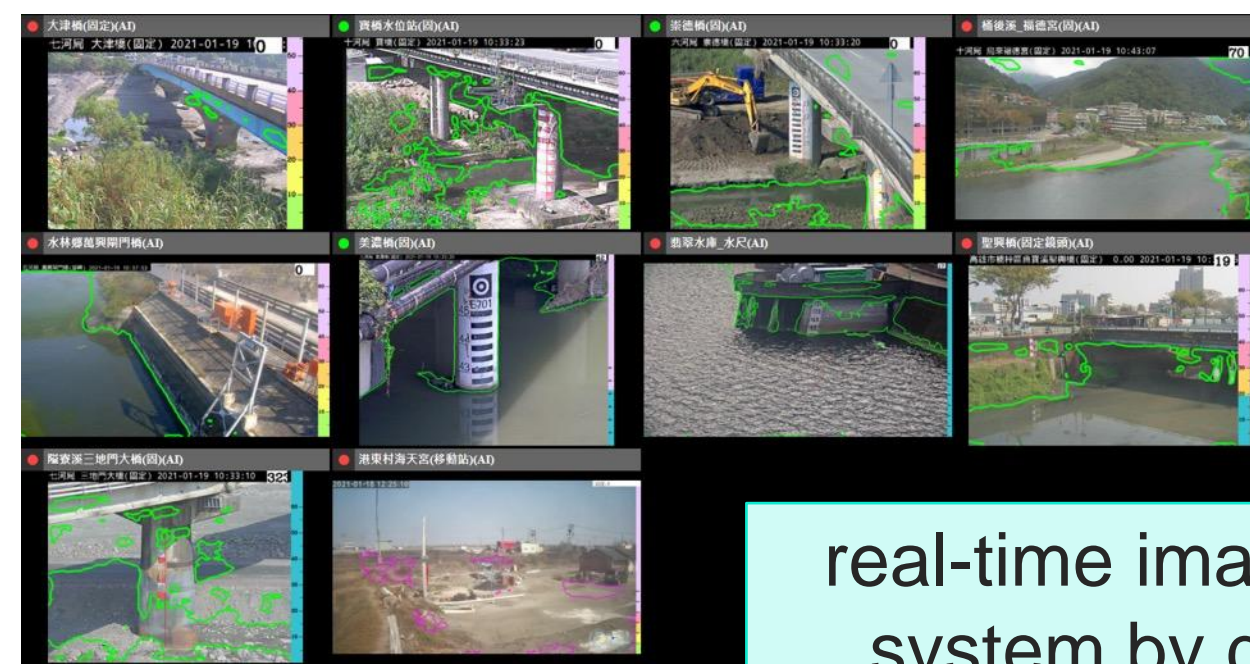
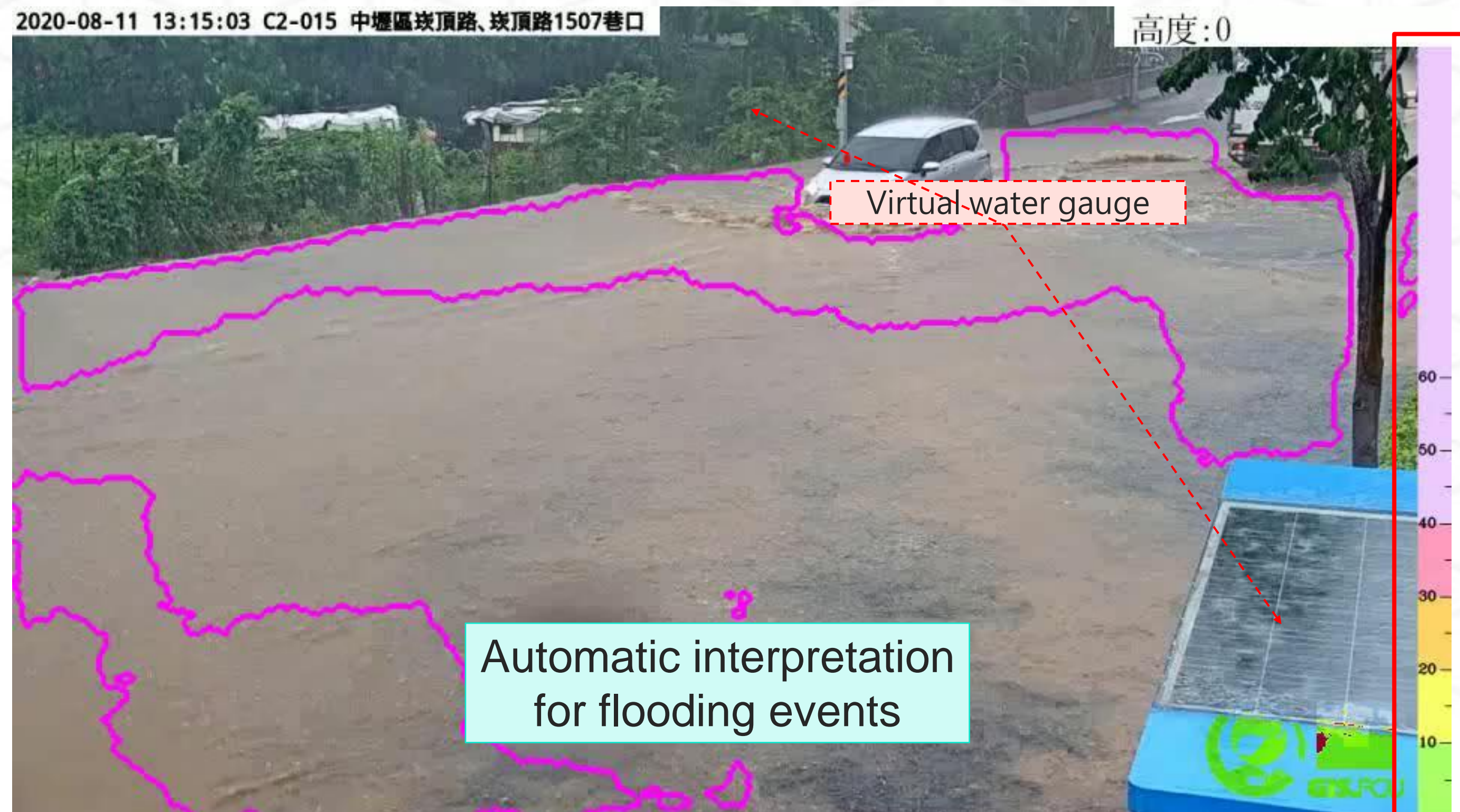
<https://www.opengeospatial.org/standards/sensorthings>

<https://www.itu.int/pub/T-FG-DPM-2019-3.2>

Integration

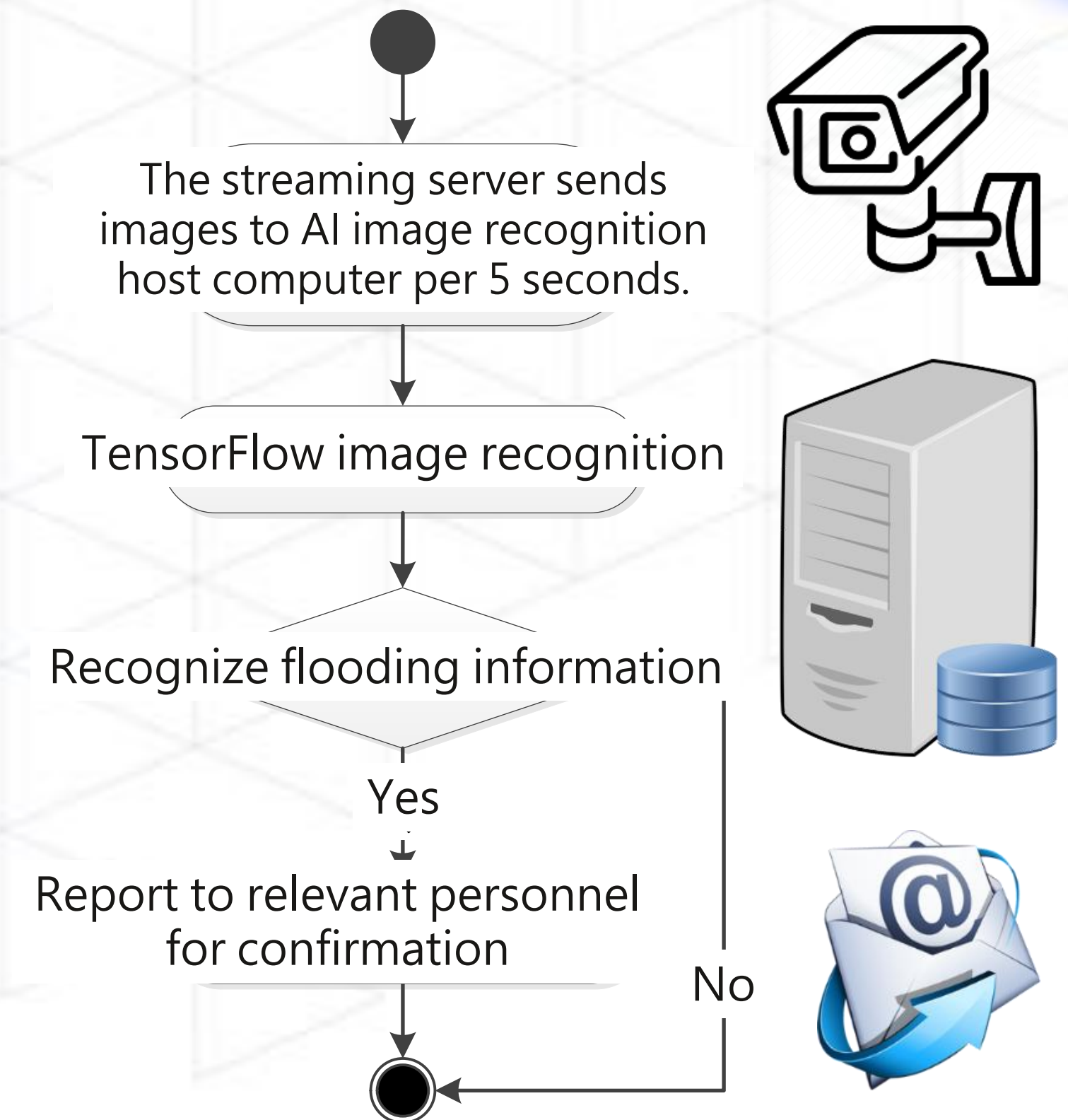


Automatic interpretation of road flooding images



AI Flooding Recognition

- Virtual water gauge
- Flooding area
- Group-based image recognition system



By playing images through the group-based real-time recognition system, relevant personnel can instantly know the AI recognition image of each surveillance camera. Click on any AI real-time recognition screen, and you can open another window to independently display the AI recognition screen of the station.

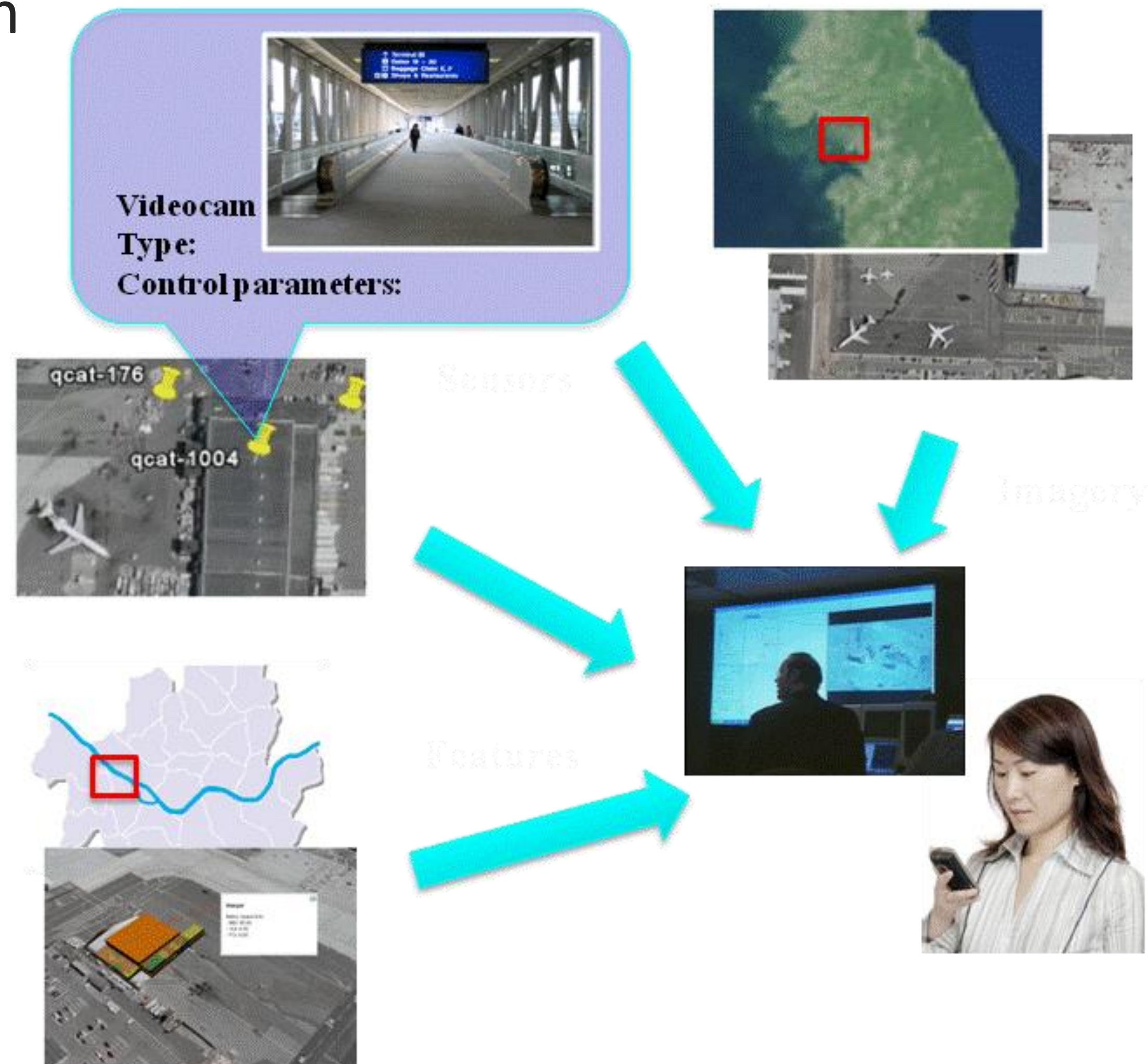
Serving and Processing Data

An aerial photograph of a vast, snow-covered mountain range. The terrain is rugged and covered in white snow, with a prominent river valley winding through the center. The sky is a clear, deep blue, and there are some wispy clouds near the horizon. The overall scene is bright and expansive.

OGC Web Services Standards

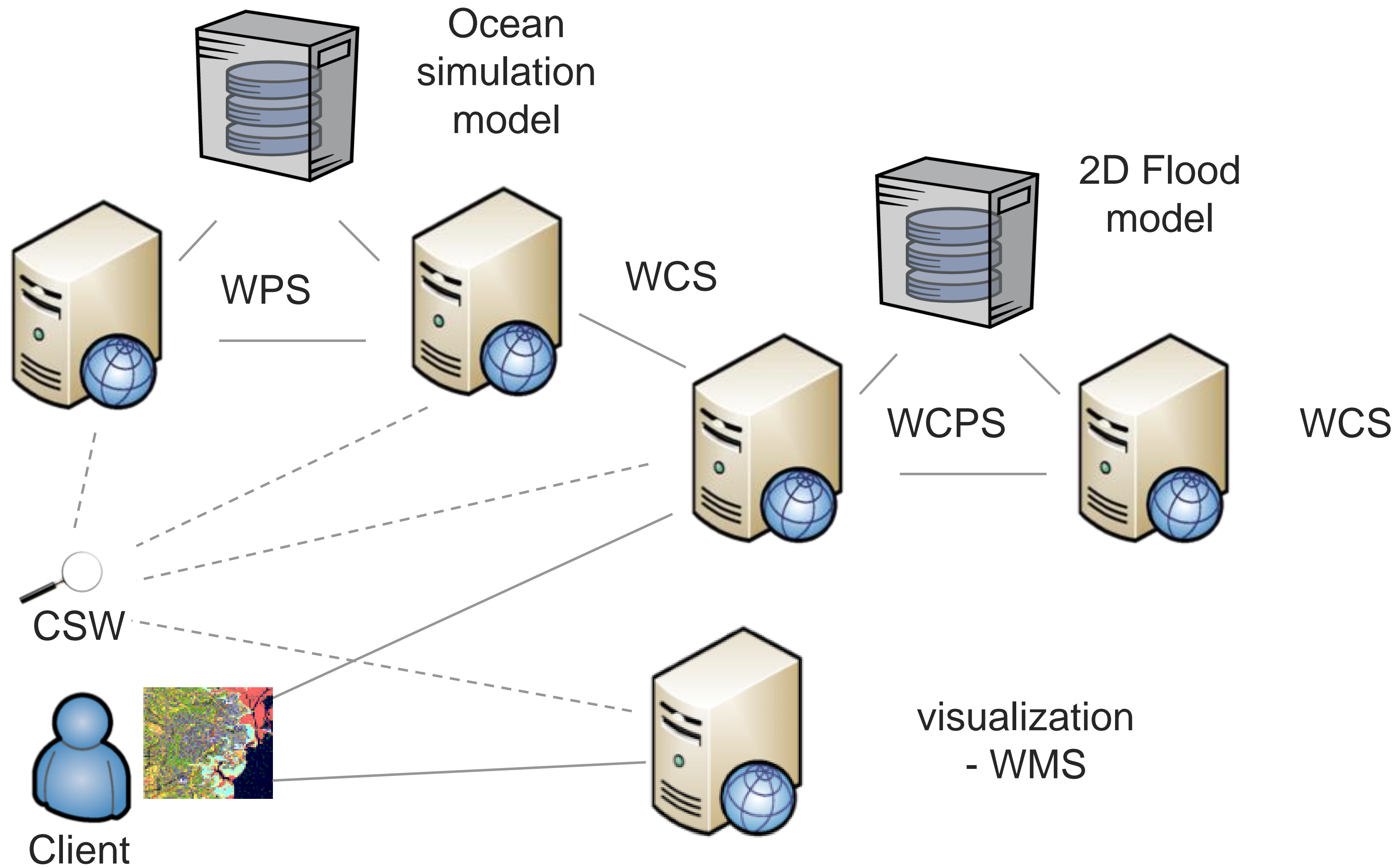
Rapid discovery, access, fusion and application of location information for:

- Catalogue (CSW)
- Geography Markup Language (GML)
- KML
- OWS Context
- Styled Layer Descriptor (SLD)
- Web Coverage Service (WCS)
- Web Feature Service (WFS)
- Web Map Service (WMS)
- Web Map Tile Service (WMTS)
- Web Map Context (WMC)
- Web Processing Service (WPS)
- Others

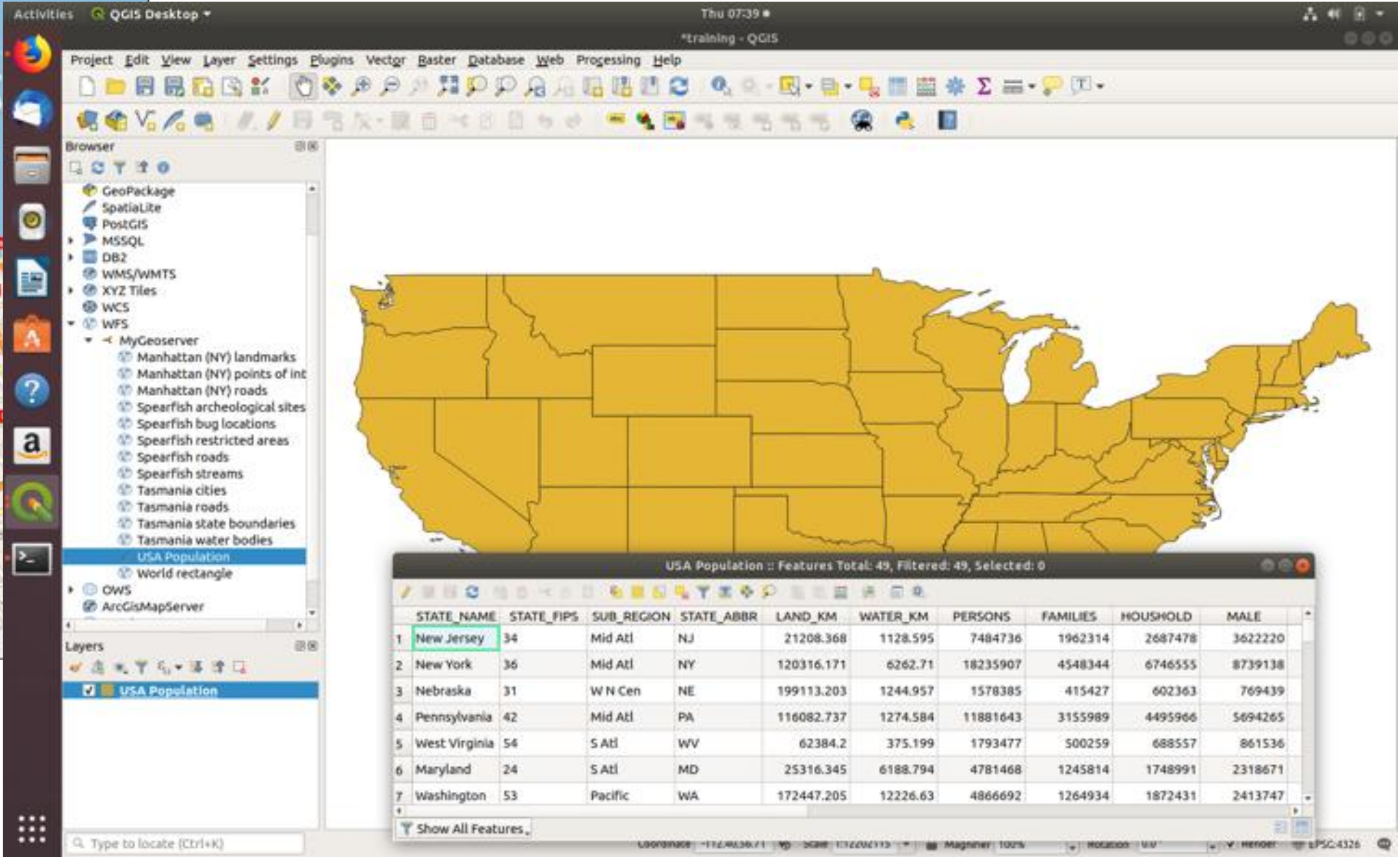
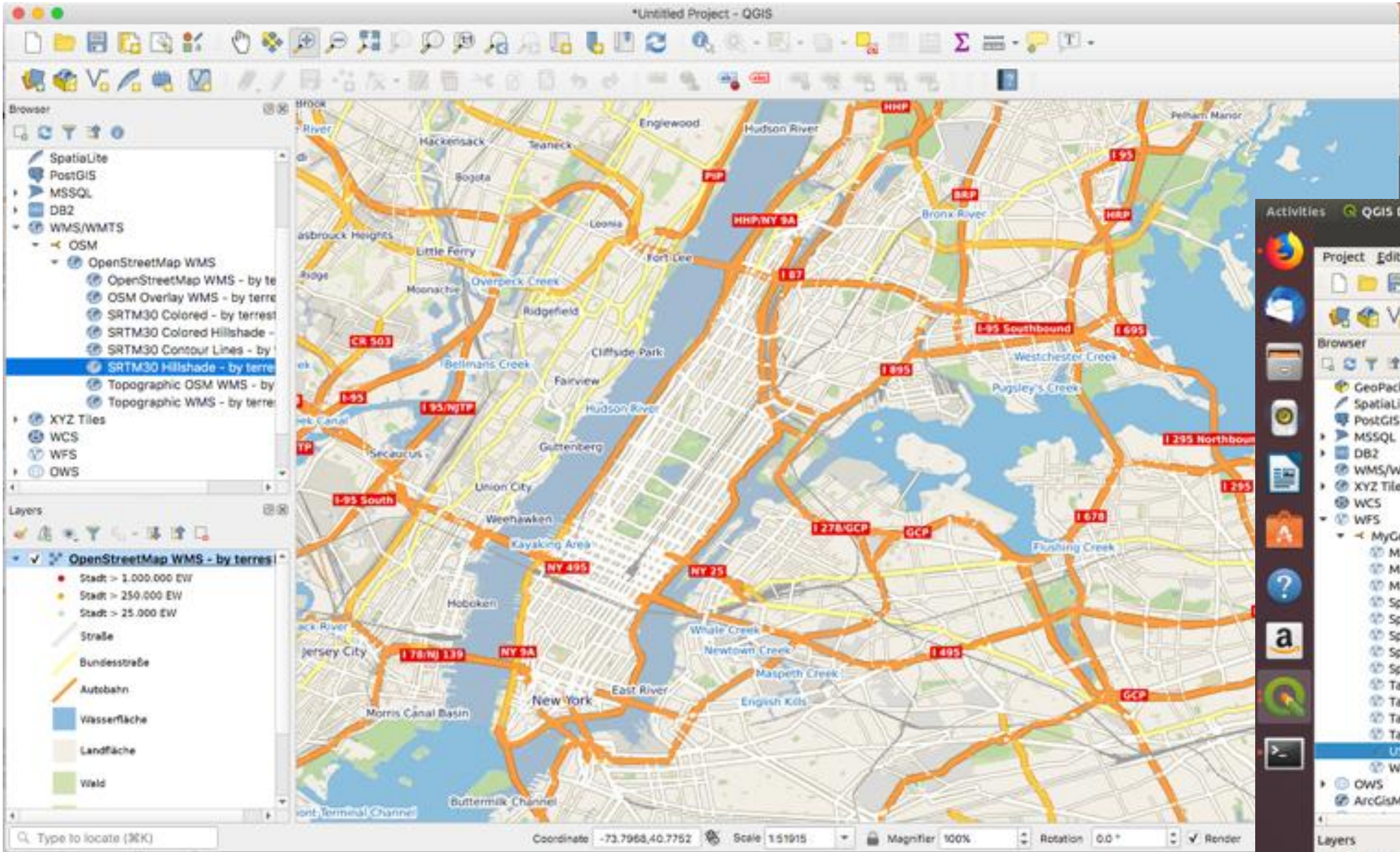


Complete OGC Standards List: <http://www.opengeospatial.org/standards>

OGC Web Services in action



WMS and WFS Usage from the Desktop



UK MET Office



Without these invaluable standards we would certainly find working with our huge customer base a much more challenging task. We see working with groups such as the OGC, W3C, WMO and ISO as key to the successful delivery of our services and will continue to invest in this important area.”

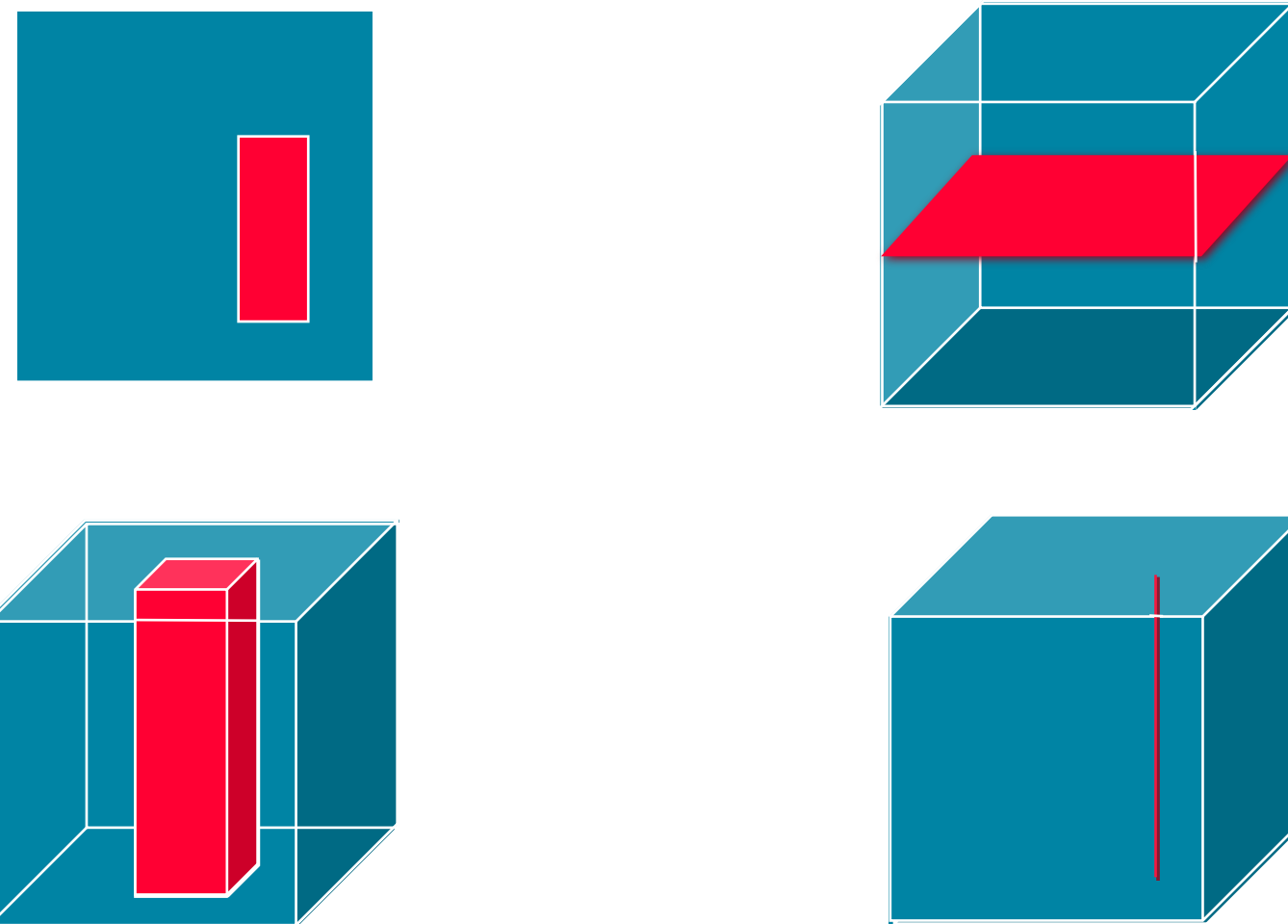
<http://www.metoffice.gov.uk/>

*Richard Carne – Head of Applications Development,
Met Office, January 29, 2014*

Web Coverage Service (WCS)

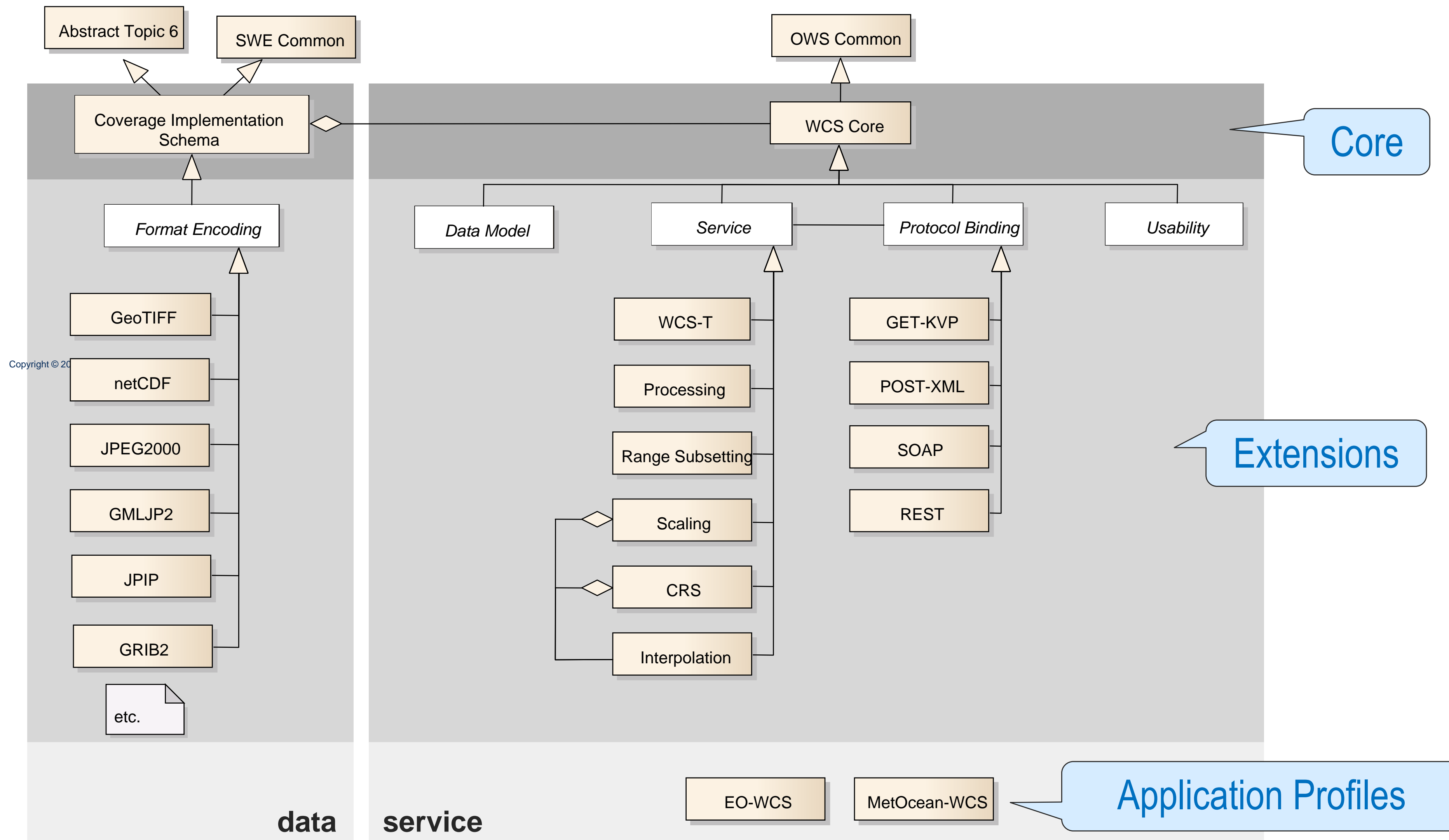
- WCS **Core**: Simple & efficient access to spatio-temporal coverages, in any suitable format

- subset = **trim** | **slice**



- WCS **Extensions**: additional, optional functionality facets
- WCS **Application Profiles**: domain-oriented bundling

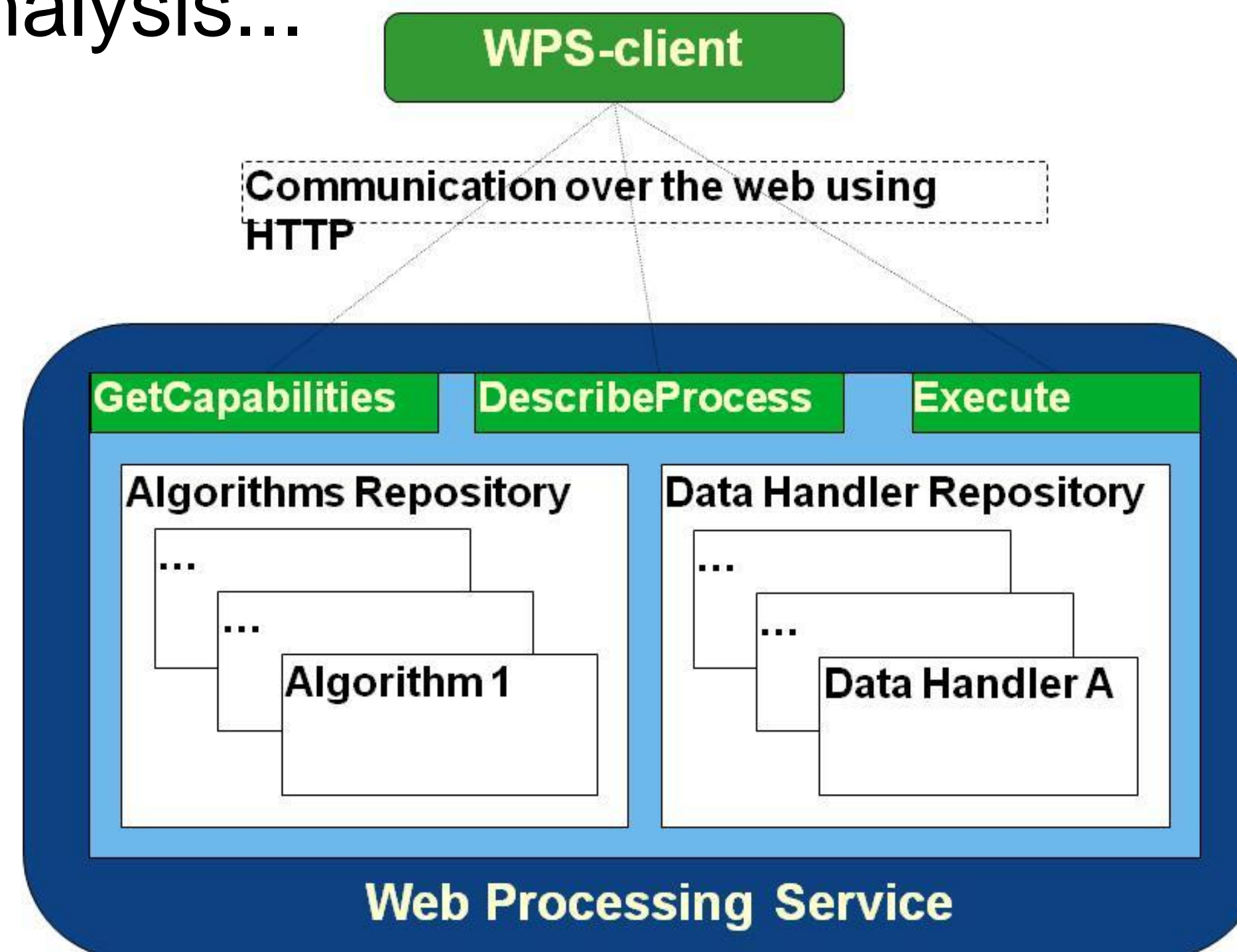
WCS 2: Big Picture



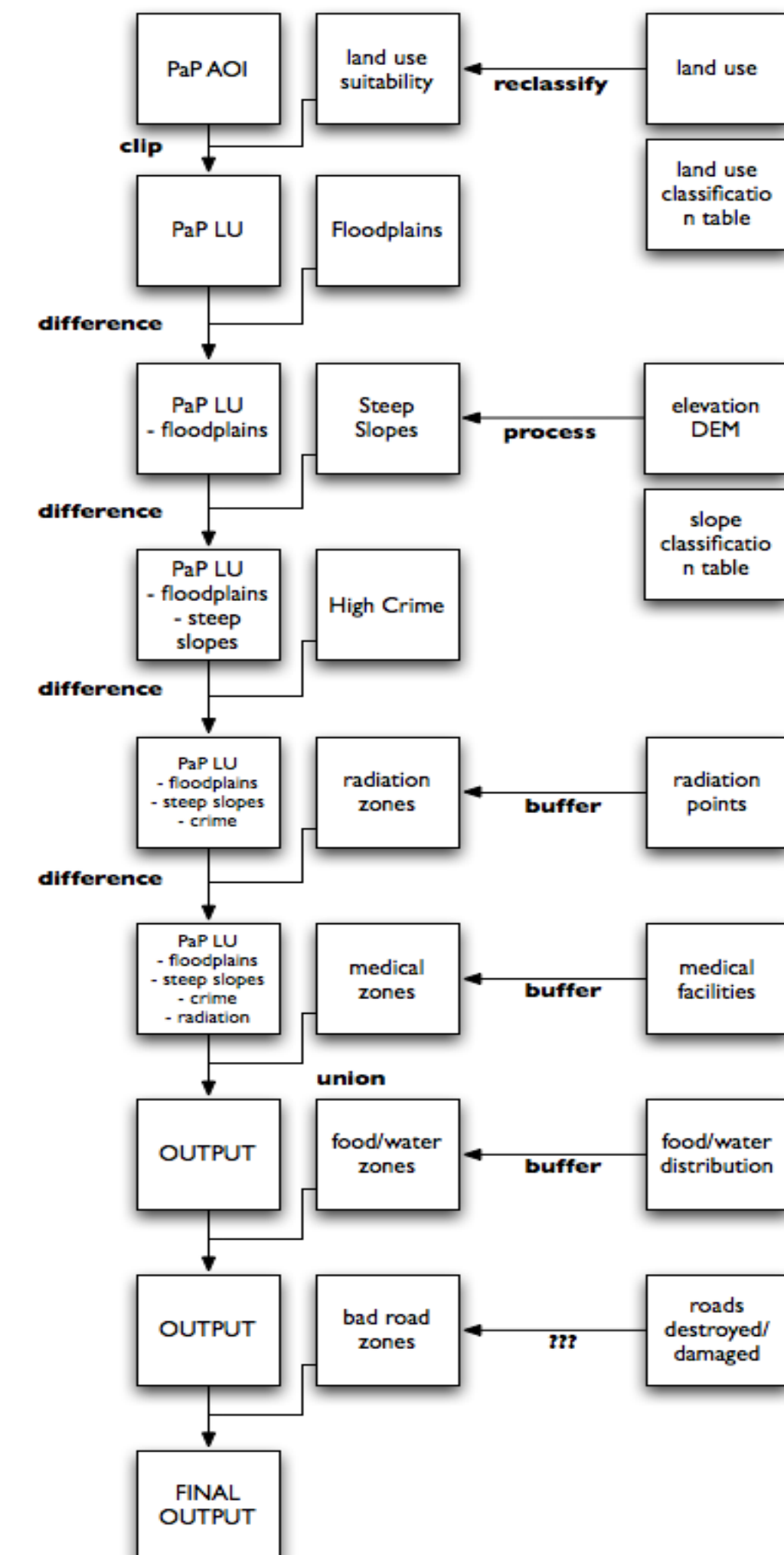
Geospatial Processing, Analysis, Workflow

Web Processing Service – WPS

- OGC Web Service workflow for algorithms
- Change detection, coordinate transformation, predictive models, simulation, geospatial analysis...



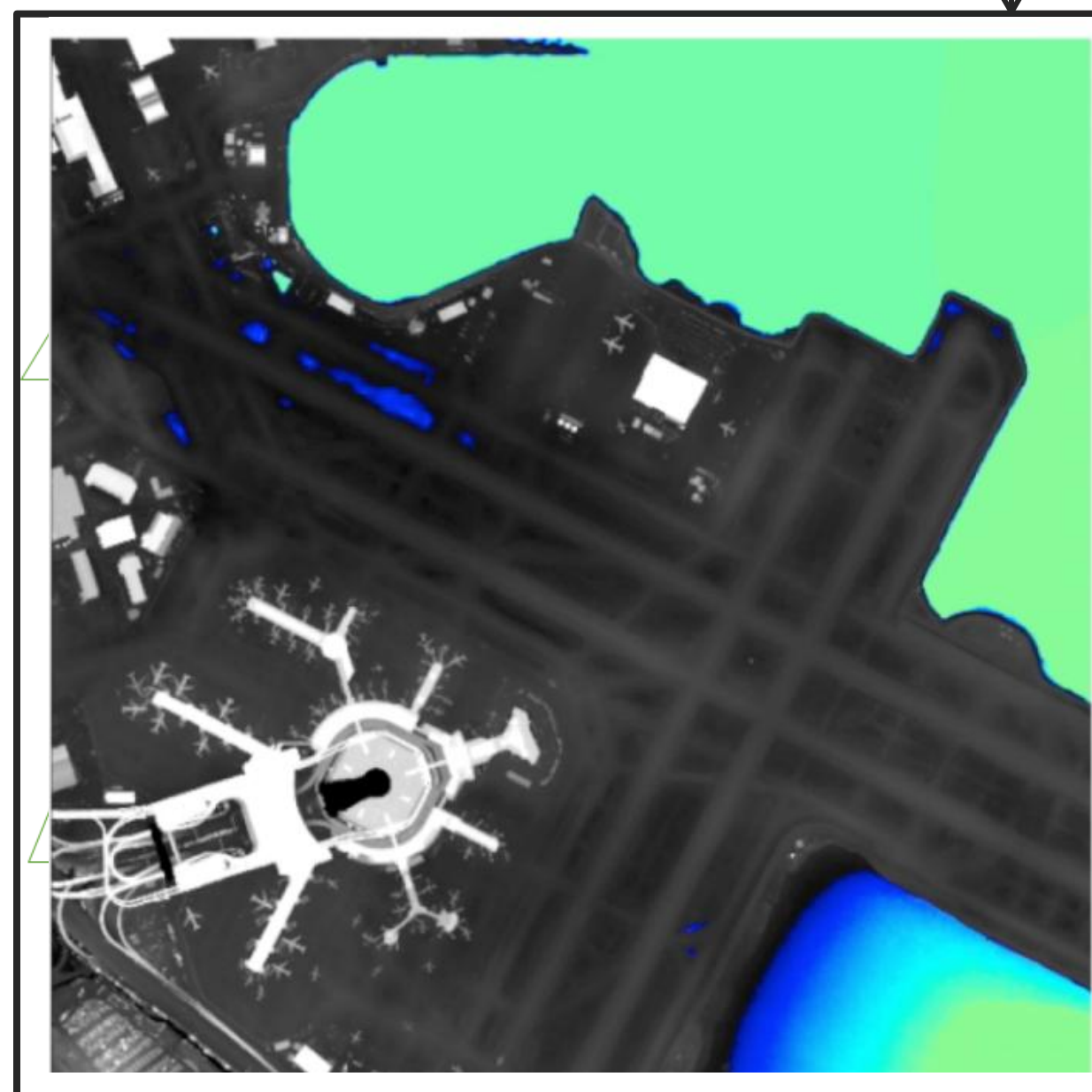
Geoprocessing Workflow



Geospatial prediction, analysis and anticipation

Predictive Models with Simple Interfaces

OGC Web Processing Service (WPS)

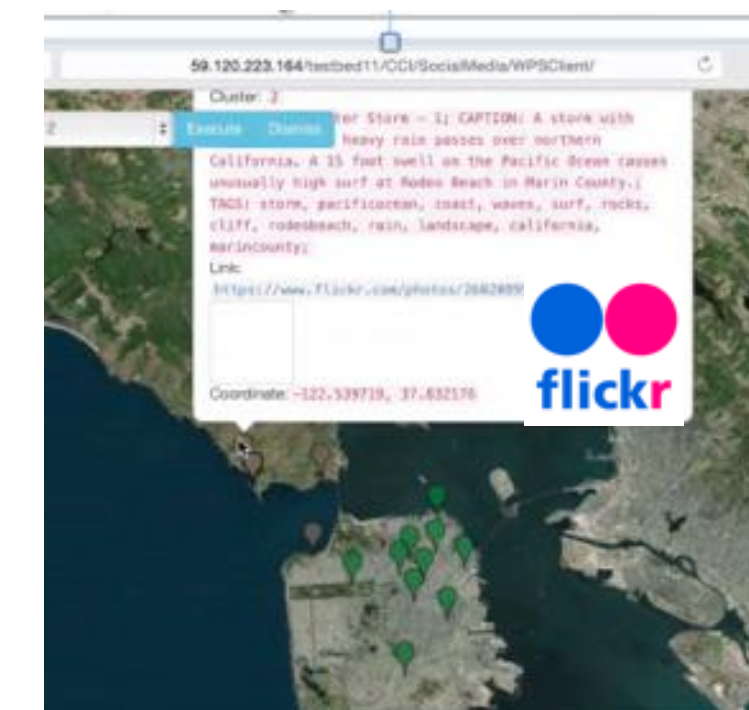


Assess situation on ground
Check predictions

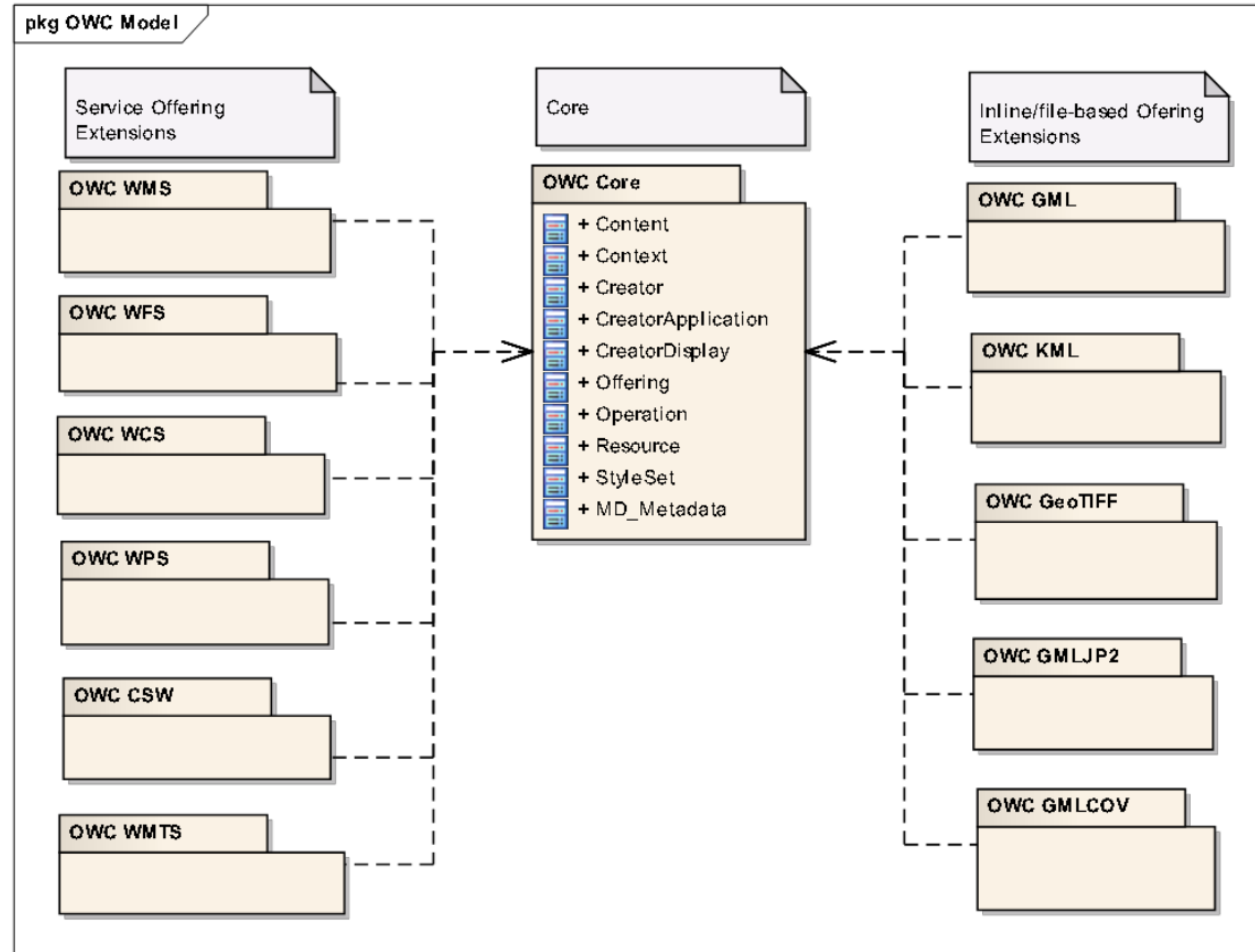


WFS Transaction

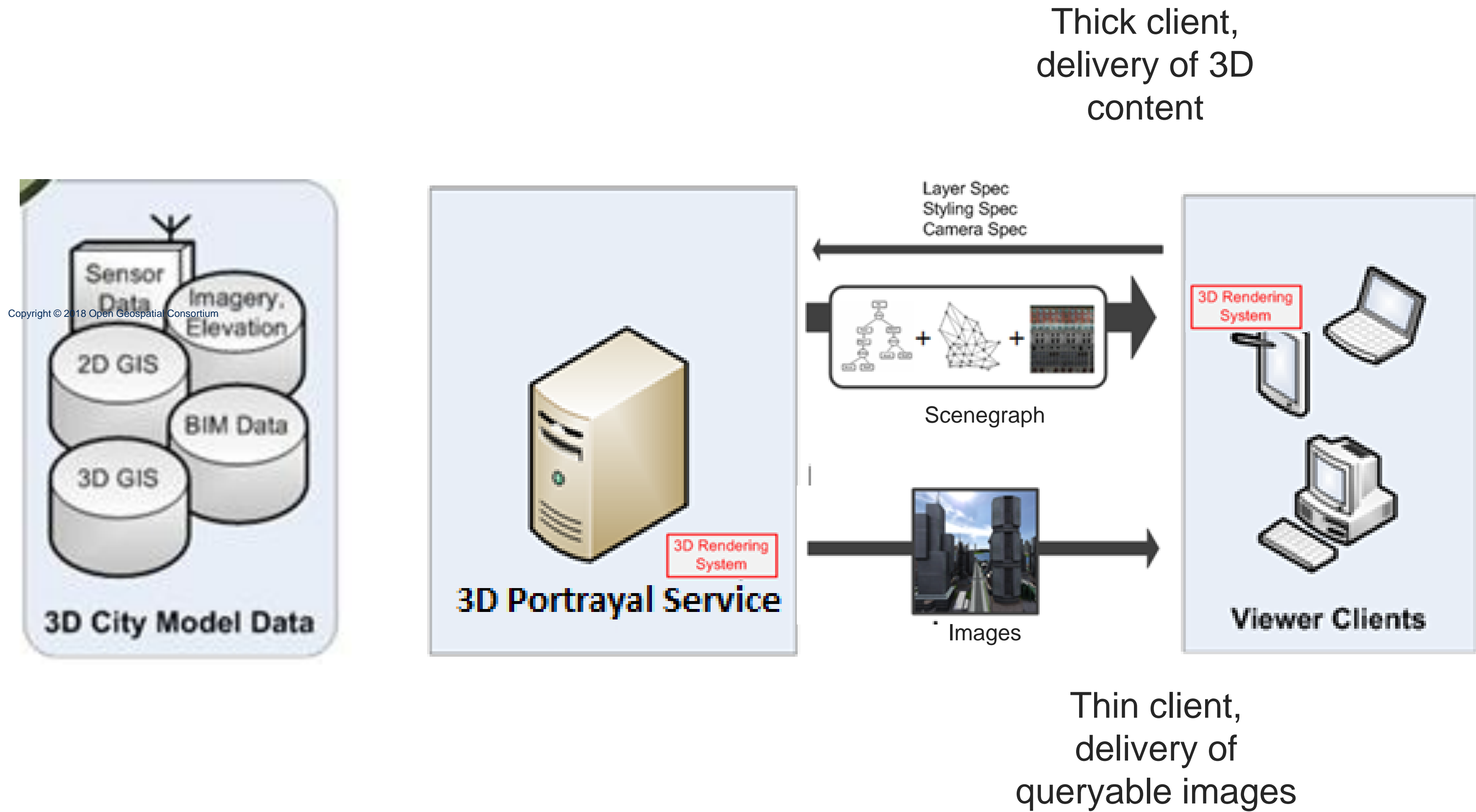
Social Media Analysis WPS



OWS Context

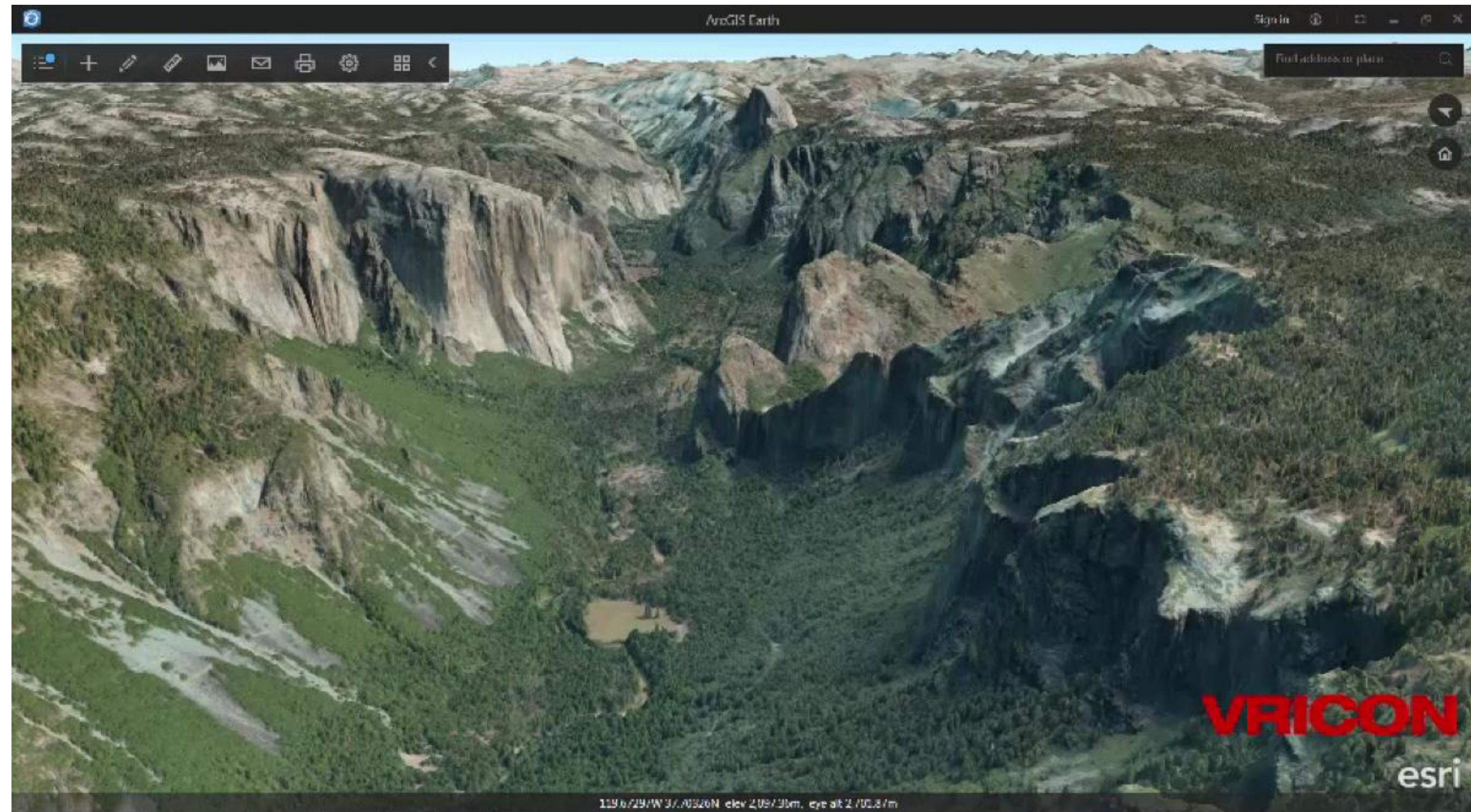


3D Portrayal Service (3DPS): delivery of data or representation



Indexed 3D Scene Layer (i3S)

- Developed by Esri
- Approved in 2017 as an OGC Community Standard
- First OGC Community Standard to be updated



3D Tiles

- Developed by Cesium
- Approved in 2018 as an OGC Community Standard



Source: Cesium



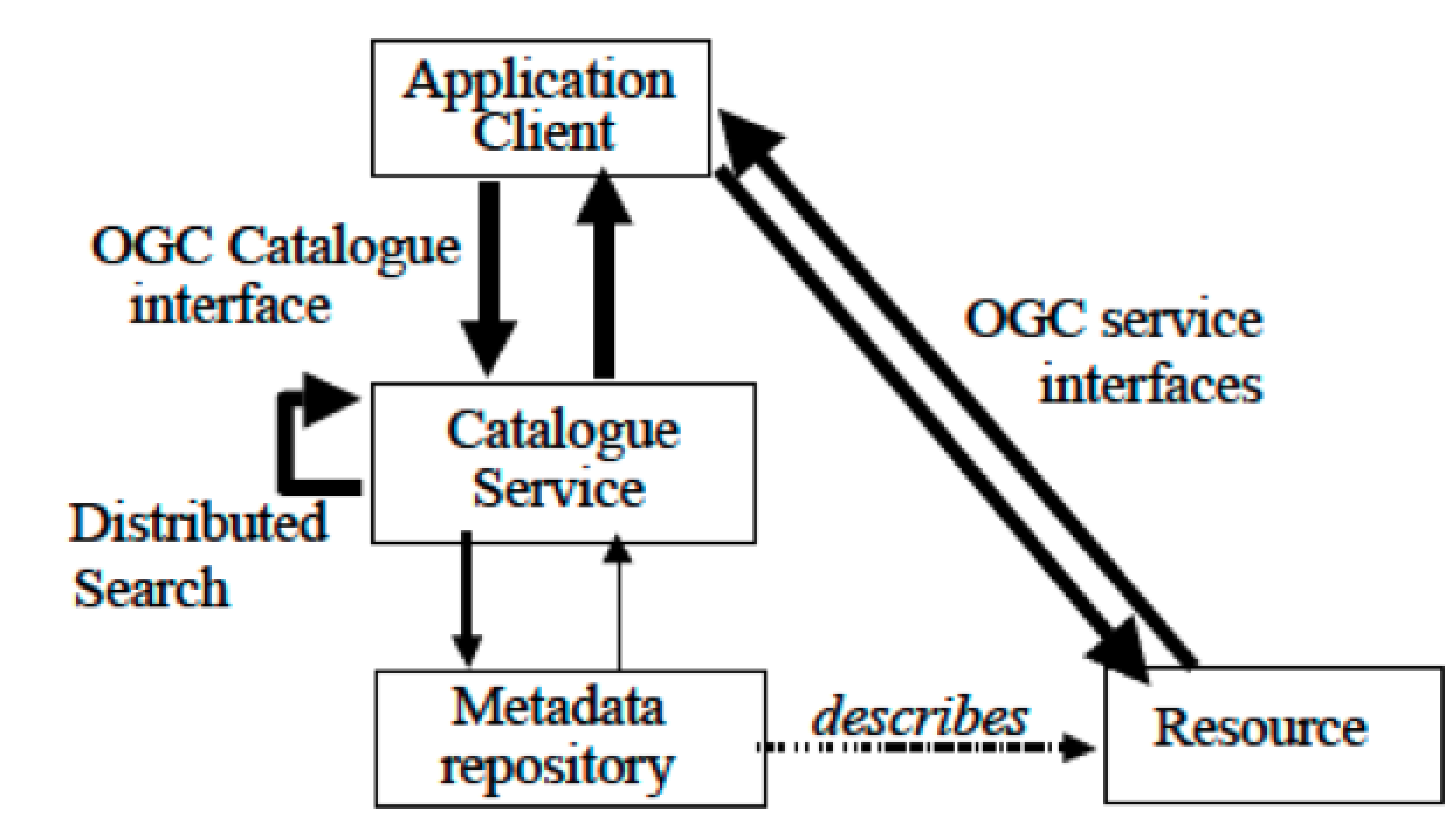
Cataloging and Searching

An aerial photograph of a vast, snow-covered mountain range. The terrain is rugged and covered in white snow, with some dark patches of rock or vegetation visible. The sky is a clear, deep blue, and there are some wispy clouds near the horizon. The overall scene is bright and expansive.

Data discovery

- Catalog Services for the Web (CSW) – provides a cataloging function for all types of OGC Web services
- OpenSearch Geo and EO – use of OpenSearch to crawl geospatial data and Earth Observation collections
- GeoSPARQL – extension to SPARQL (a RDF/graph data query language)

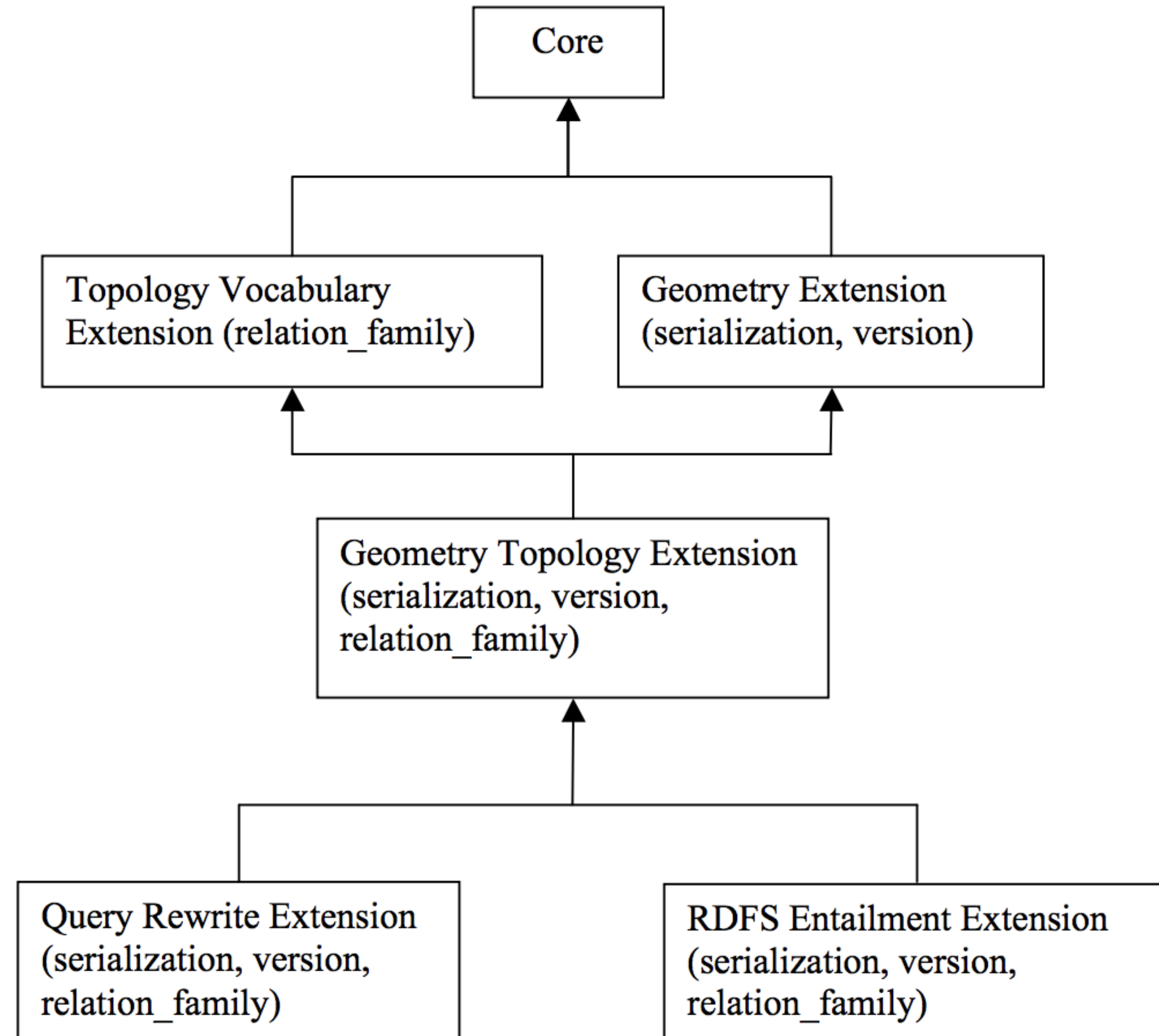
Catalog Services for the Web (CSW)



OpenSearch Geo and EO

Opensearch Parameter	Dublin Core element name	OGC queryable term	Atom Response Element
searchTerms	title description subject	Title AnyText Abstract Subject	atom:title atom:summary atom:category
geo:box geo:geometry geo:lat, geo:lon and geo:radius geo:relation geo:name	coverage	BoundingBox	georss:*
geo:uid	identifier	Identifier	dc:identifier
time:start, time:end and time:relation ^a			dc:date
^a The temporal queryables should be mapped to the intersection of the data content values			

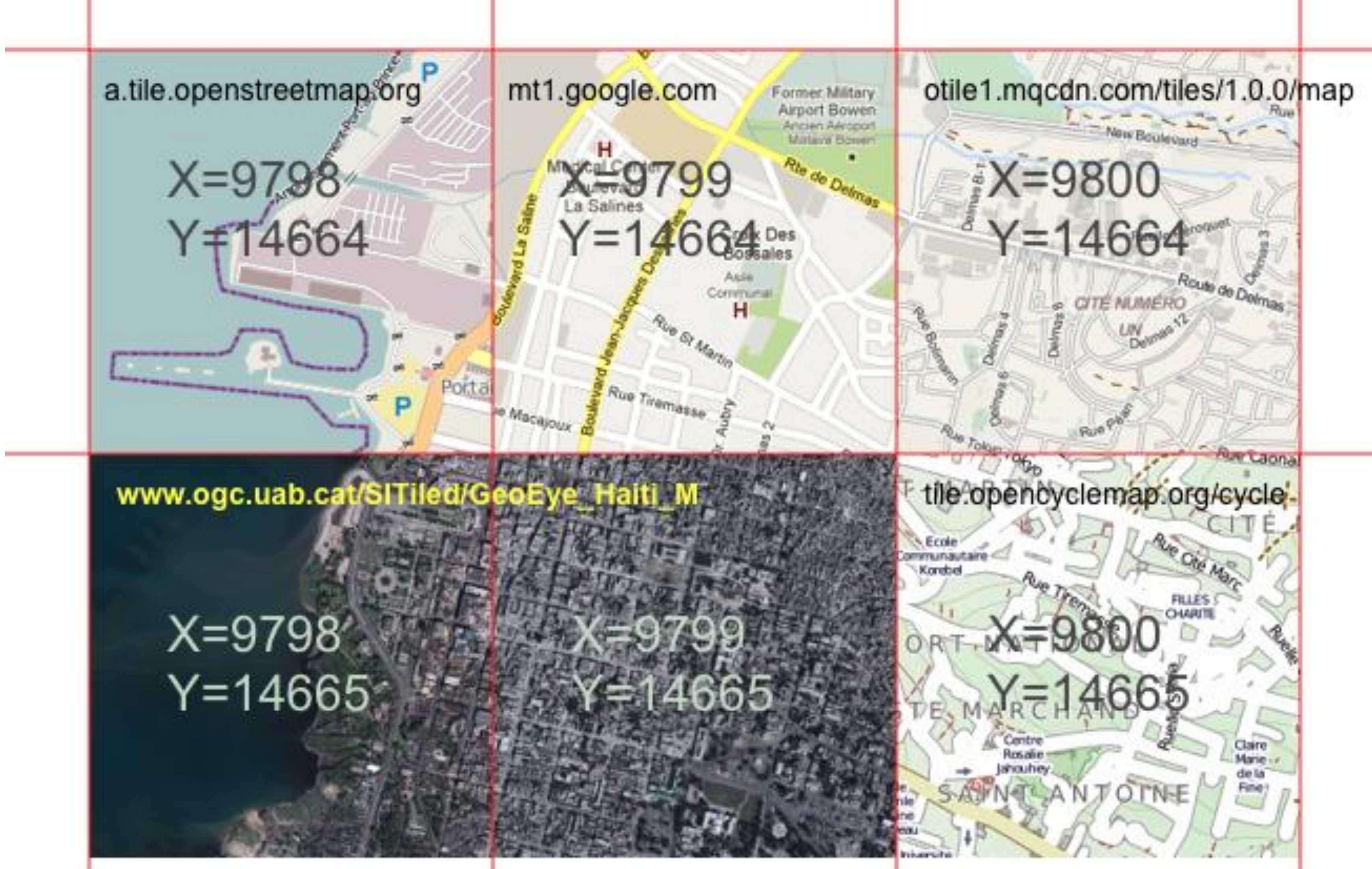
GeoSPARQL



OGC APIs

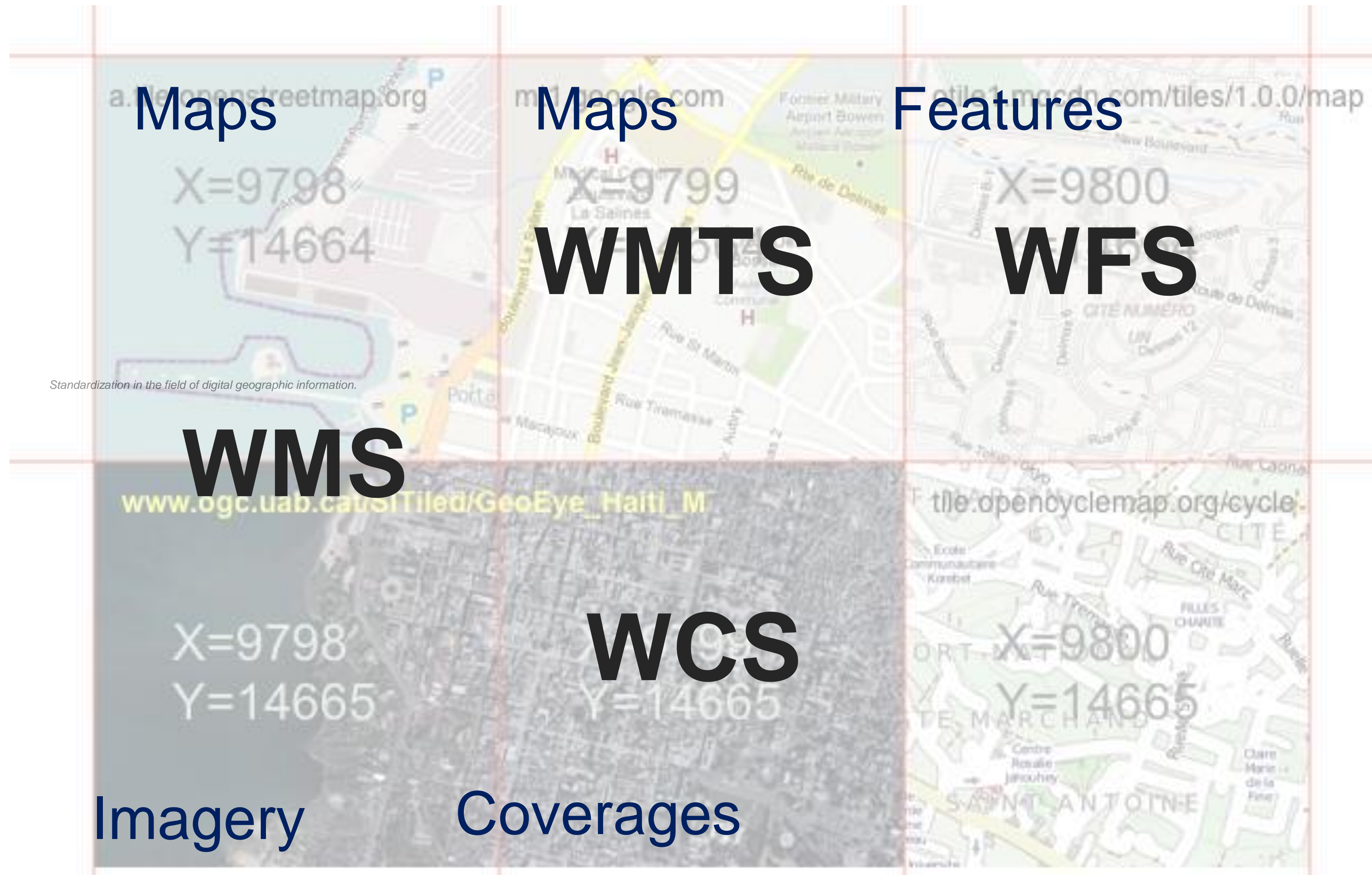
An aerial photograph of a vast, snow-covered mountain range. A prominent river valley winds through the center of the landscape, with a road or railway line following its course. The terrain is rugged, with numerous peaks and ridges covered in snow. The sky is a clear, deep blue, and there are scattered white clouds, particularly in the lower right and middle ground. The overall scene is bright and expansive.

APIs with consistent elements allow Interoperability



Multiple Maps with common semantics - Interoperability (Source: Joan Maso)

Legacy OGC Web Service Standards



Multiple Maps with common semantics - Interoperability (Source: Joan Maso)