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POLITECNICO DI MILANO
Polo regionale di Como

Hydro Informatics Lab
Politecnico di Milano





Free and Open Source Software and Web Services Specializing in the Water Sources Domain

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- Web Map and Geodata Clients
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Part II. Architecture of FOSS/Web Services systems

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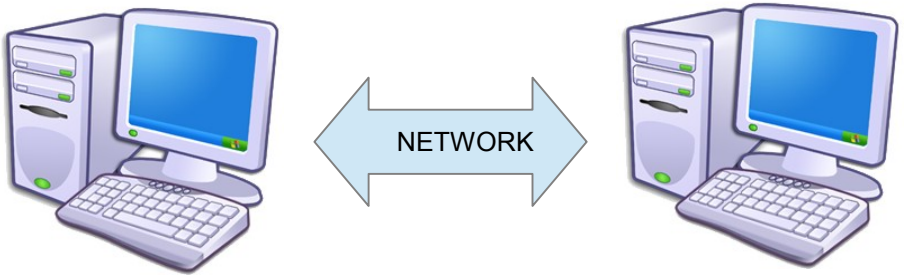
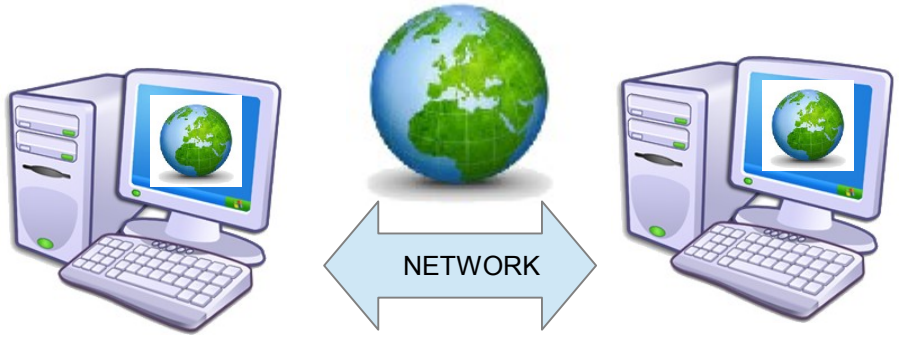
Geospatial Web Services



Web Service

"...a software system designed to support interoperable machine to machine interaction over a network"



Geospatial Web Service

"...allows geospatial data and functions to be interoperable"

Interoperability

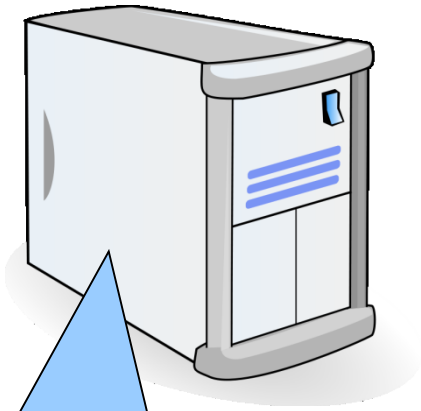
Interoperability is the capability to communicate, execute programs or transfer data among various functional units in a manner that requires the user to have little or no knowledge of the unique characteristics of those units (ISO/IEC 2382-01, Information Technology Vocabulary, Fundamental Terms)

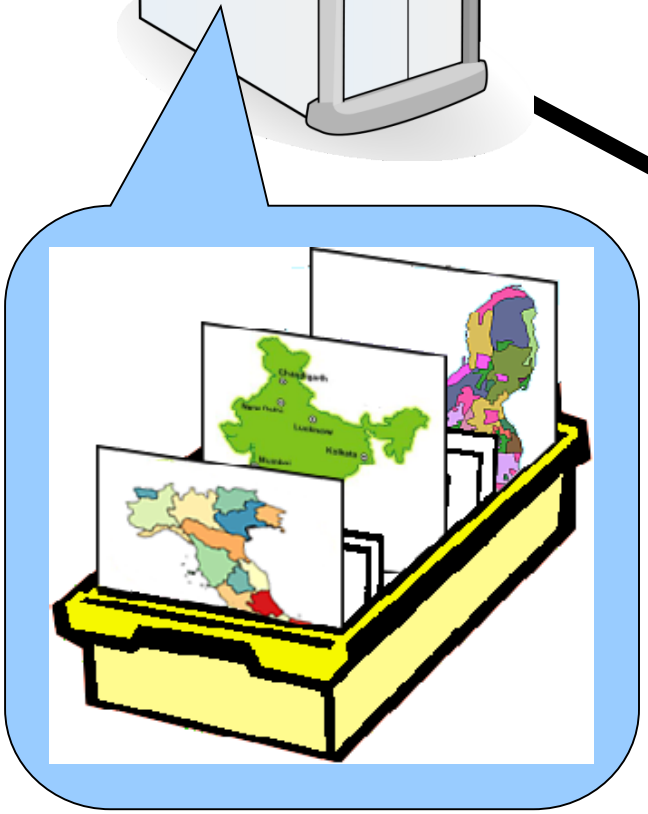
Examples of interoperabile components needed by a distributed GIS:

- Catalogues (collections of metadata, that is information on available objects and operators)
- Data archives
- Viewers and editing tools
- Operators (e.g. for transformation, filtering, integration,…)

Web mapping

Geodata Servers

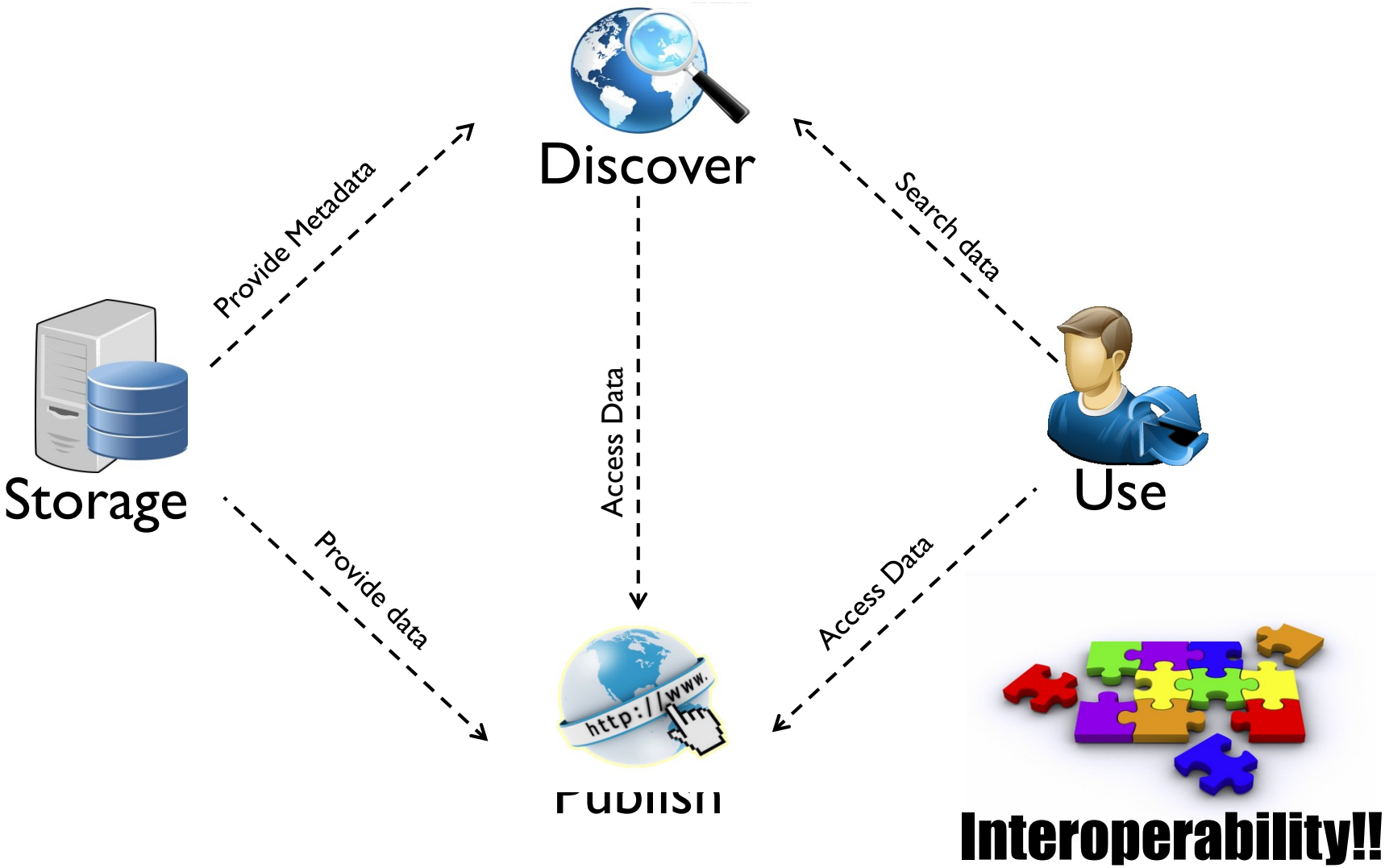




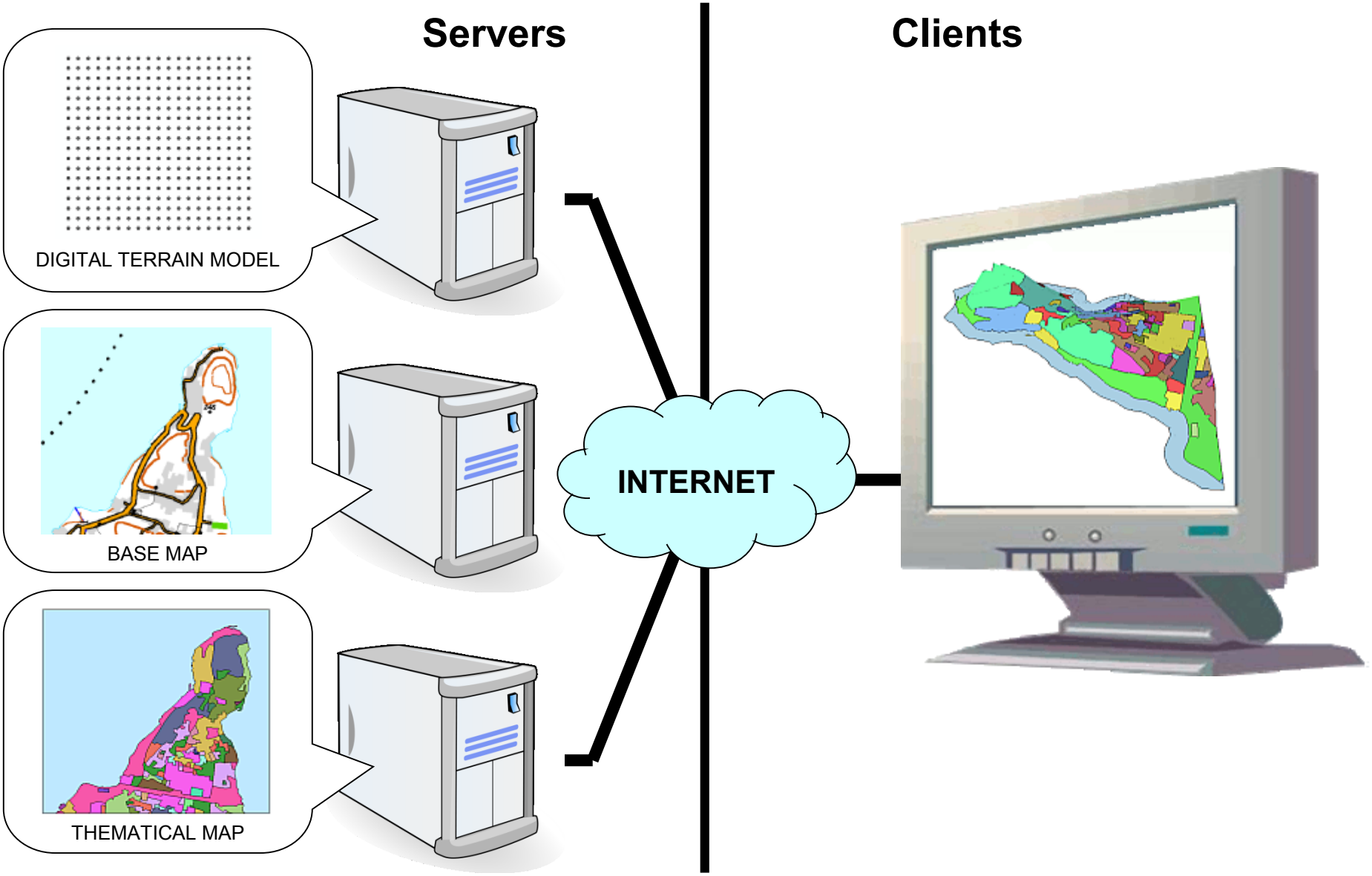
INTERNET

Geodata Clients

Spatial Data Infrastructures



Map mashing-up



Standardization

In order to obtain the interoperability standards are needed

De facto standard: technical instruction used by a noteworthy number of people and/or organizations (i.e. shp, dxf, …)

De jure standard: technical instruction set by national and/or international standardization organizations (W3C, ISO, OGC, National standards, ...)

W3C World Wide Web Consortium

ISO International Organization for Standardization

OGC® Open Geospatial Consortium, Inc.

(TC211 - geographic information and geomatics)

OGC Web Services (OWS)

- OGC Web Services expose geographical functionality to Web users through a standard Web protocol
- XML based: the use of the “eXtensible Markup Language” allows to encoding data, rules and functions in a format that is both human-readable and machine-readable:

Web Services are platform and OS-independent

- The functioning of OWS can be described in four steps:
  - The client contacts the server and queries it about its functionalities
  - The server sends back to the client an XML document containing the functionalities of the supported service
  - The client asks the server for data
  - The server provides the data as requested

OWS - Data Delivery Services (2)

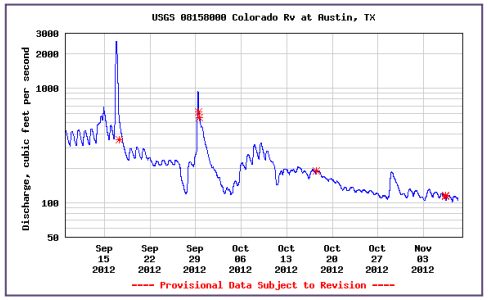
Most frequently used water data delivery services

- **WMS**: service that generates maps and makes them available as image → RASTER
- **WFS**: service that generates geographic entities or features. If the service is "transaction" (WFS-T), data manipulation is allowed → VECTOR
- **WCS**: service that generates geospatial coverages, that are geospatial information representing space-varying phenomena (fields) → GRID
- **SOS**: service that generates metadata and observations from heterogeneous sensor systems → DATA (XML)

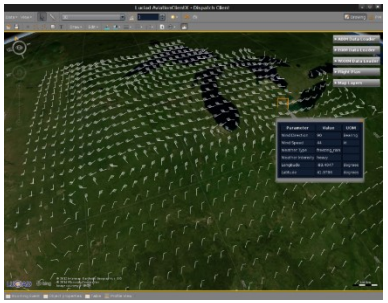
Water Data Framework

Temporal

Time Series
(WaterML2 and .csv)

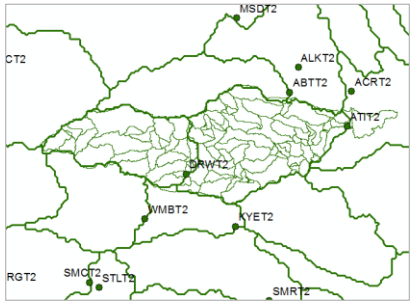


Multidimensional Arrays
(WCS and netCDF)

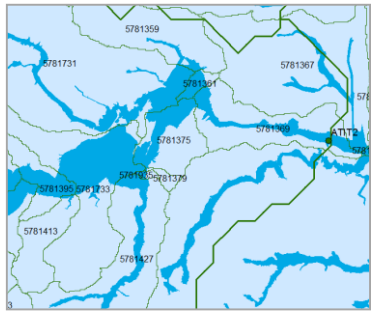


Geospatial

Hydrology
(RFC Basins,
NHDPlus Catchments)



Hydraulics
(National Flood Hazard Layer,
Flood Inundation Map Libraries)



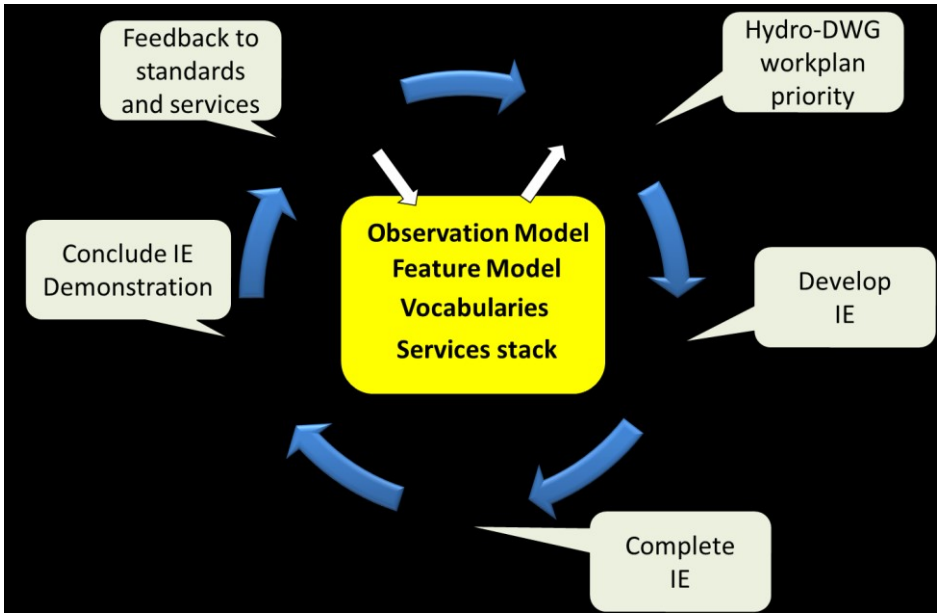
Slide source: David Maidment

International Standardization of WaterML

Hydrology Domain Working Group

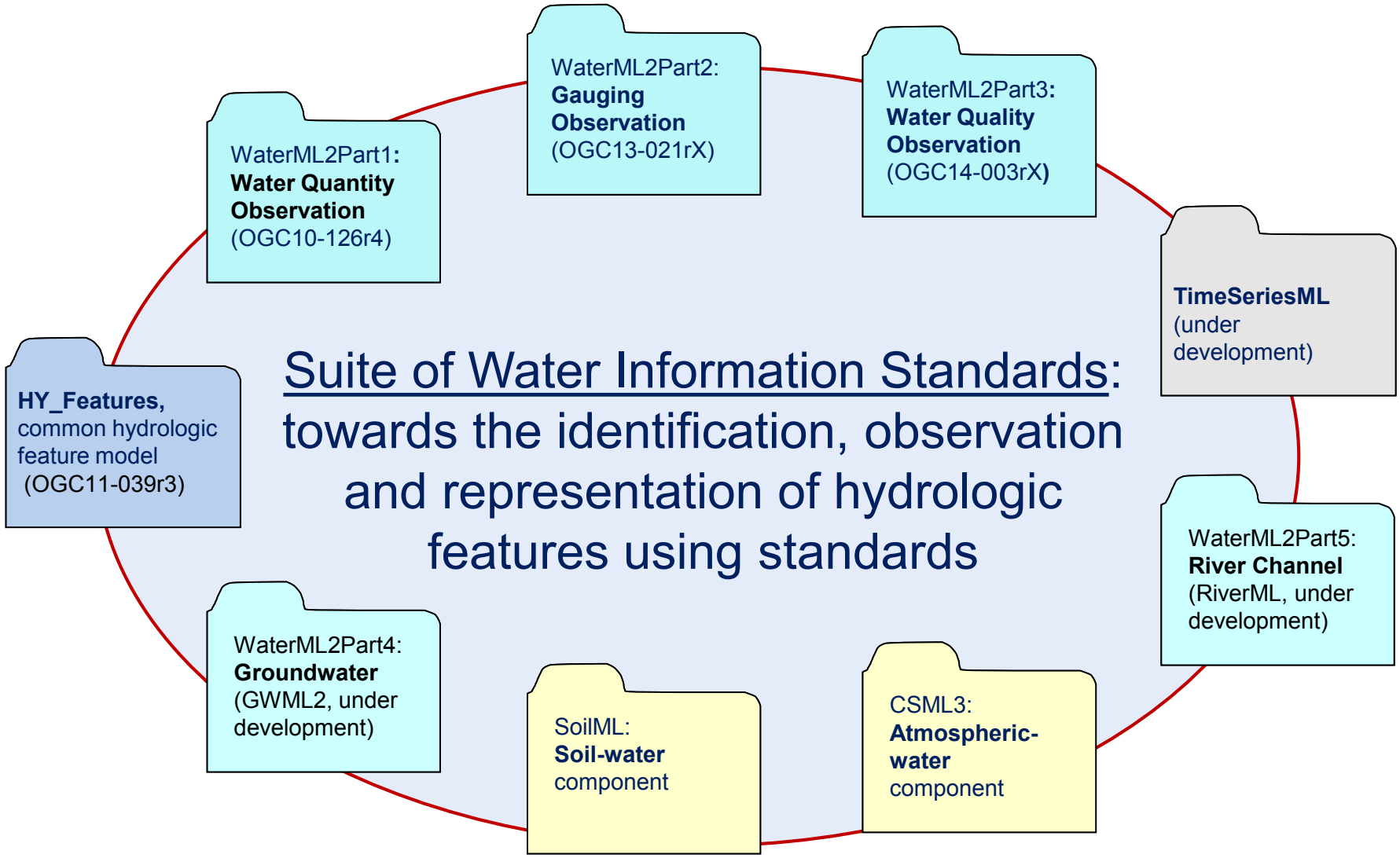
- ☑ Standards for water data: **WaterML 2.0 suite**
- ☑ Organizing Interoperability Experiments (IEs) focused on different sub-domains of water

Iterative Development



http://external.opengis.org/twiki_public/bin/view/HydrologyDWG/WebHome

HydroDWG: Suite of Water Information Standards



Other OCG Standards

Data formats:

- **SFS**: Simple Feature Standard
- **GML**: Geography Markup Language
- **CityGML** : storage of virtual 3D city models
- **KML**: Keyhole Markup Language
- **NetCDF**: OGC Network Common Data Form
- ...

Services and specification:

- **WMTS:** Web Map Tile Service
- **CTS:** Coordinate Transformation Service
- **WCPS:** Web Coverage Processing Service
- GeoAPI Implemenation
- Filter Encoding
- ...

FOSS Software for a Water SDI (1)

Server Side

MapServer
open source web mapping

GeoServer

GeoNetwork opensource

deegree

PostGIS
Spatial PostgreSQL

geomajas

52north
exploring horizons

istSOS

ZOO

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Client Side

uDig

OpenLayers™

Mapbender

geomajas

gvSIG

p.mapper

OPEN JUMP

mapfish

GRASS

Quantum GIS

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Citizen Science

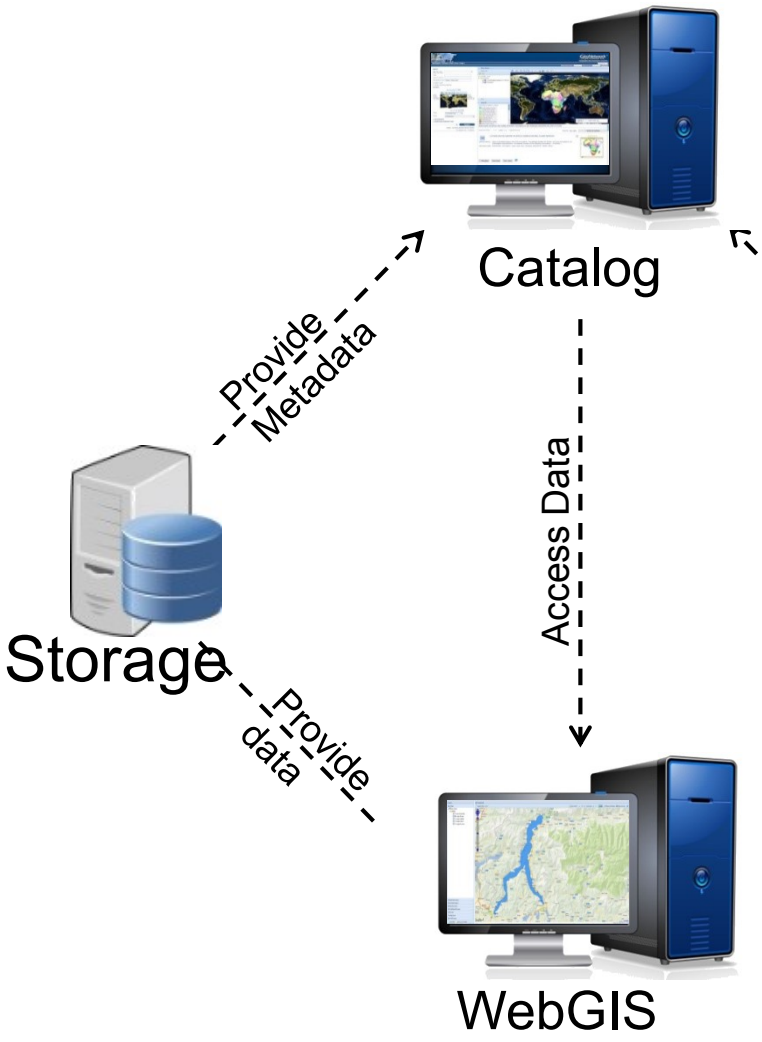
- ✓ Set of practices in which citizens participate in data collection, analysis and dissemination of a scientific project
- ✓ Active or passive
- ✓ Explicit or implicit
- ✓ Classification

- → 'classic' citizen science: citizens engaged in traditional scientific activities
- → community science: measurements and analysis carried out by amateurs in order to set action plans to deal with environmental problems
- → citizen cyberscience: use of computers, GPS receivers and mobile phones

  - ✗ volunteered computing: citizens download data, run analyses on their own computers and send back data to the server
  - ✗ volunteered thinking: citizens perform classification works
  - ✗ participatory sensing: applications centered on mobile phones capabilities

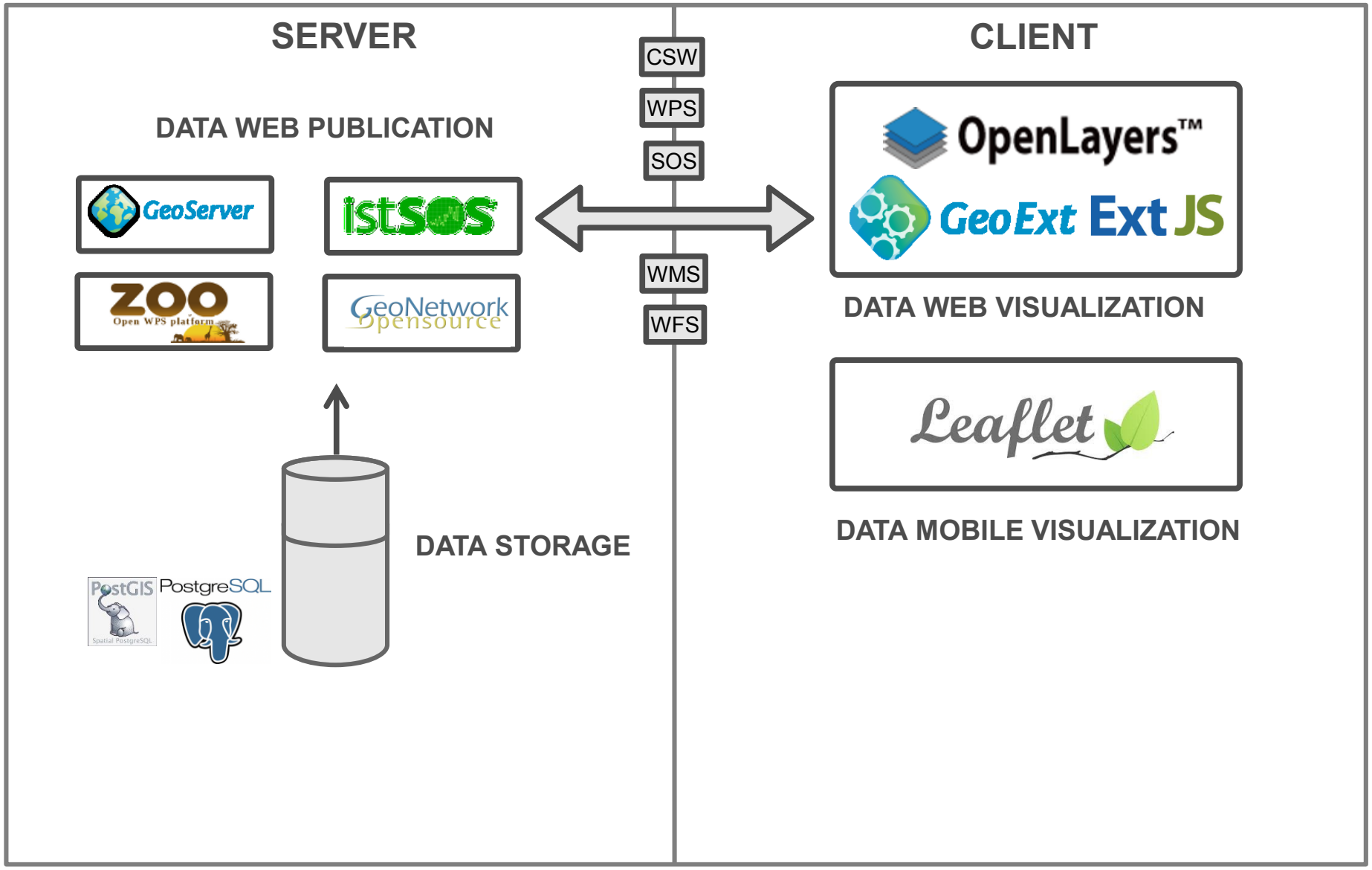
Part II. Architecture of FOSS/Web Services systems

Water SDI

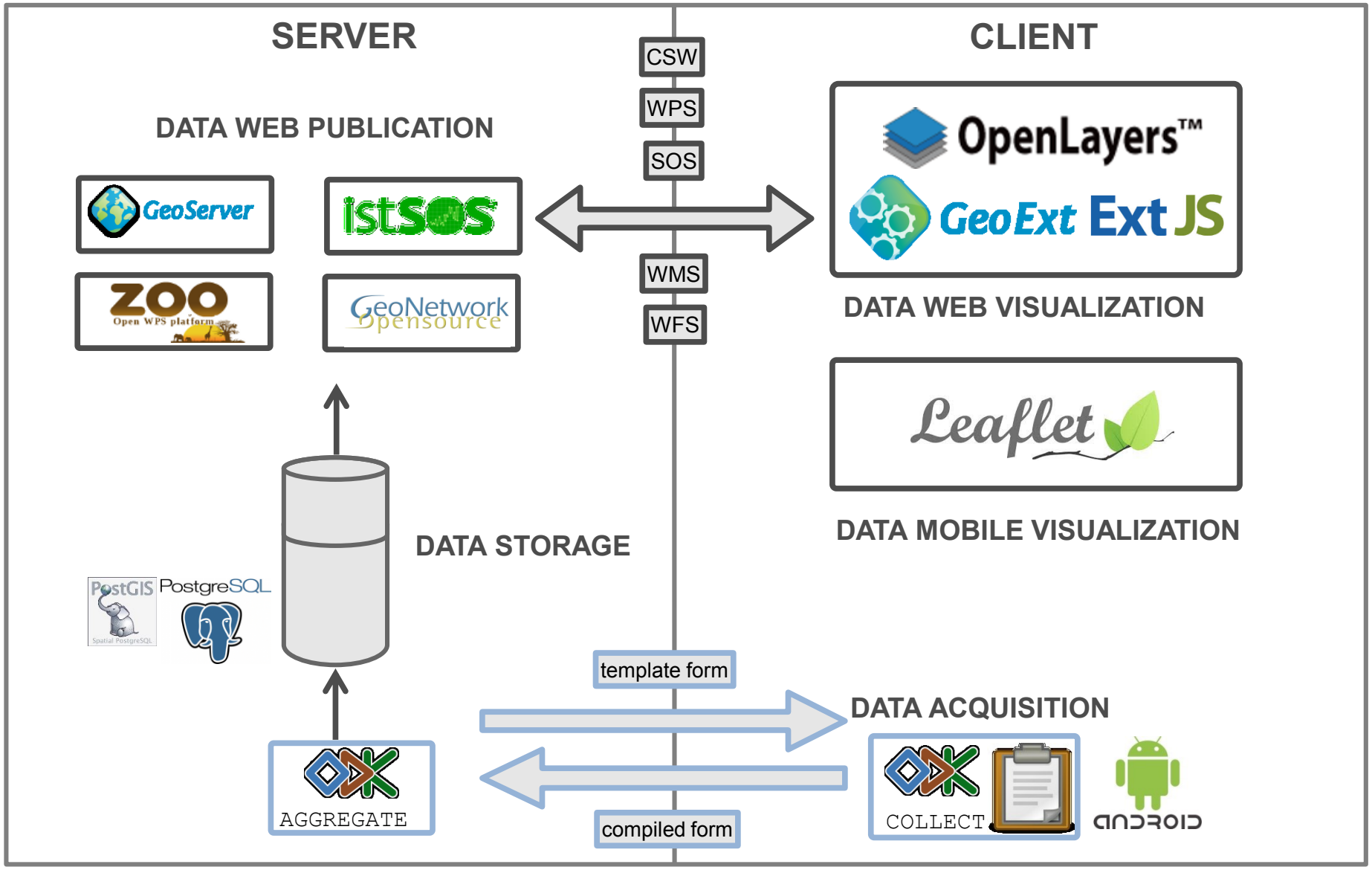


- hydro electrical power generation
- water supply for municipalities
- surface water hydrology
- monitoring and warning
- river basins
- wastewater and stormwater
- groundwater hydrology
- water quality
- flood risk management and response
- reservoir and irrigation systems management

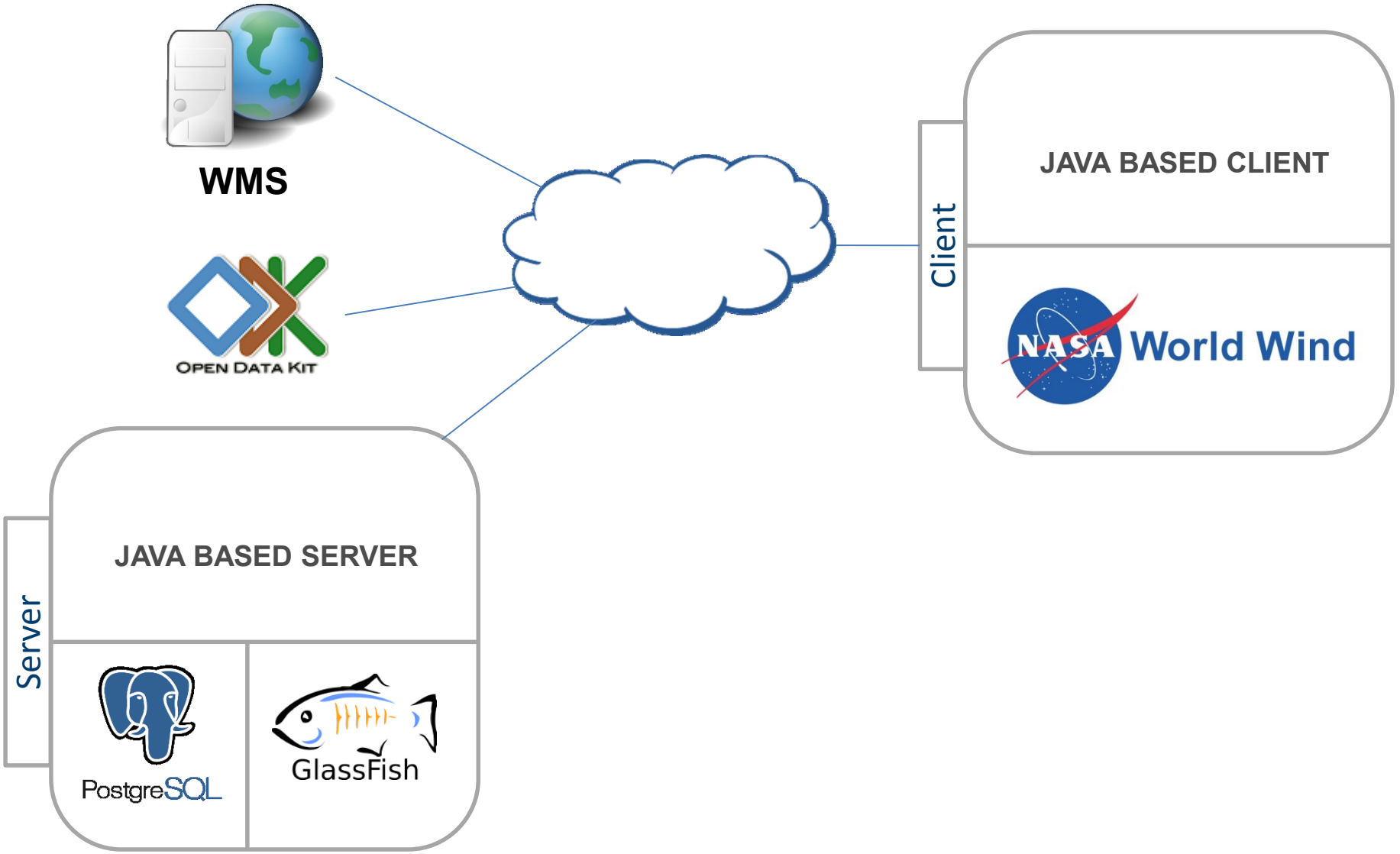
Water SDI FOSS architecture



Citizen science FOSS architecture



SDI FOSS architecture + 3D



Thank you for your attention!

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