

GeoServer, the open source server for interoperable spatial data handling

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Outline

- **Who is GeoSolutions?**
- **Quick intro to GeoServer**
- **What's new in the 2.2.x series**
- **What's new in the 2.3.x series**
- **What's cooking for the 2.4.x series**

GeoSolutions

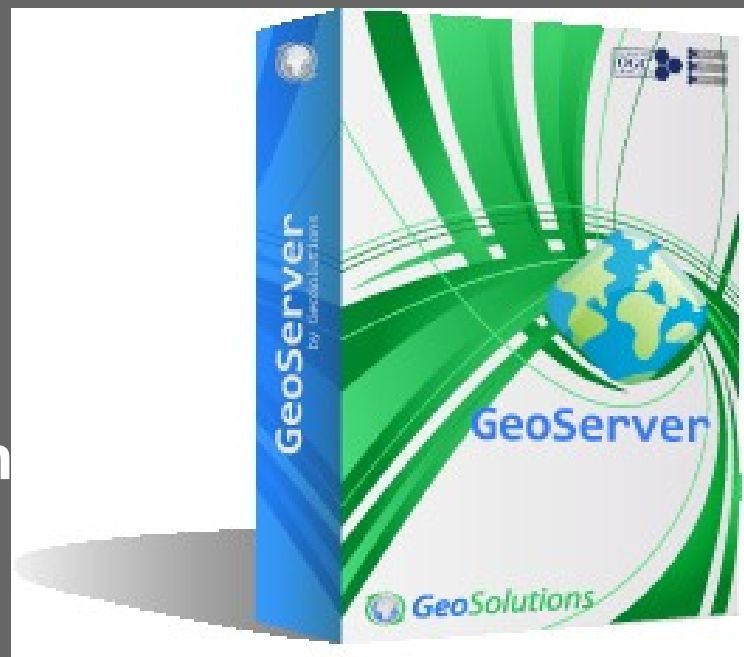
- **Founded in Italy in late 2006**
- **Expertise**
 - Image Processing, GeoSpatial Data Fusion
 - Java, Java Enterprise, C++, Python
 - JPEG2000, JPIP, Advanced 2D visualization
- **Supporting/Developing FOSS4G projects**
 - GeoTools, GeoServer
 - GeoNetwork, GeoBatch, MapStore
 - ImageIO-Ext and more: <https://github.com/geosolutions-it>
- **Focus on Consultancy**
 - PAs, NGOs, private companies, etc...



GeoServer quick intro

GeoServer

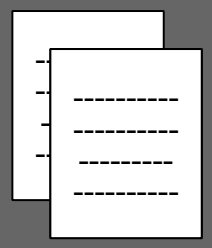
- **GeoSpatial enterprise gateway**
 - Java Enterprise
 - Management and Dissemination raster and vector data
- **Standards compliant**
 - OGC WCS 1.0, 1.1.1 (RI), 2.0 in the pipeline
 - OGC WFS 1.0, 1.1 (RI), 2.0
 - OGC WMS 1.1.1, 1.3
 - OGC WPS 1.0.0
- **Google Earth/Maps support**
 - KML, GeoSearch, etc..





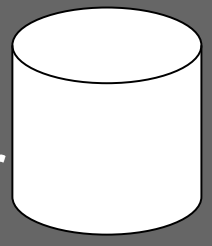
Formats and Protocols

Shapefile



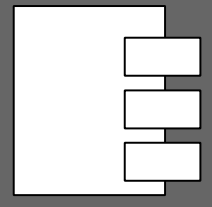
Vector files

PostGIS
Oracle
H2
DB2
SQL Server
MySQL
Spatialite
GeoCouch



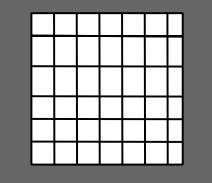
DBMS

ArcSDE
WFS

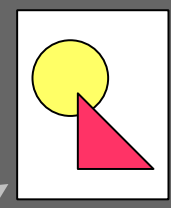
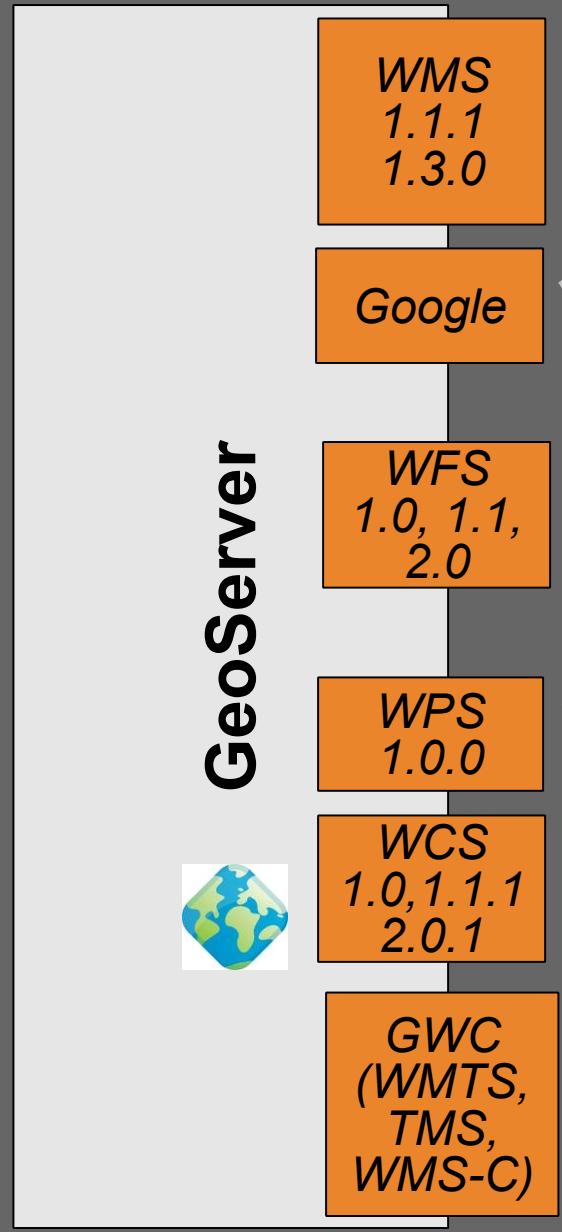


Servers

GeoTIFF
WMS
ArcGrid
GTopo30
Img+world
Mosaic
MrSID
JPEG 2000
ECW, Pyramid, Oracle GeoRaster, PostGis Raster

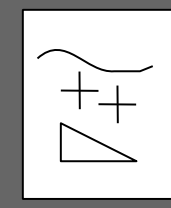


Raster files



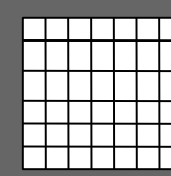
Styled maps

PNG, GIF
JPEG
TIFF,
GeoTIFF
SVG, PDF
KML/KMZ



Raw vector data

Shapefile
GML2
GML3
GeoRSS
GeoJSON
CSV/XLS

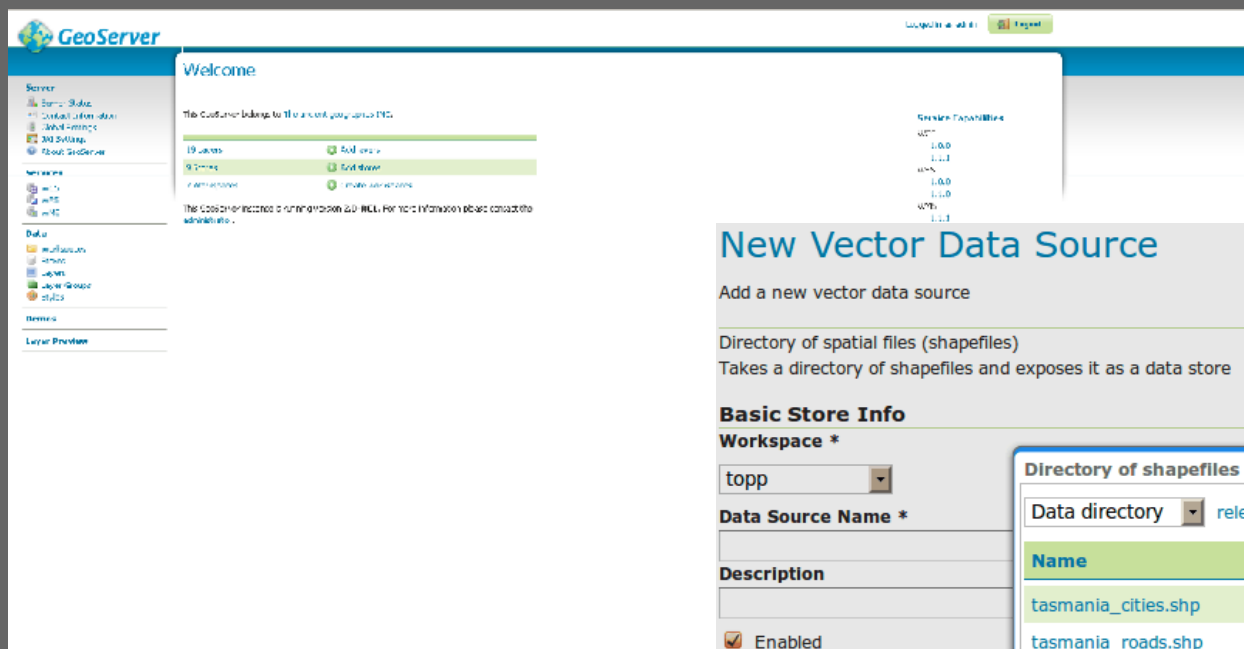


Raw raster data

GeoTIFF
ArcGrid
GTopo30
Img+World

KML superoverlays
Google maps tiles
OGC tiles
OSGEO tiles

Administration GUI



New Vector Data Source

Add a new vector data source

Directory of spatial files (shapefiles)
Takes a directory of shapefiles and exposes it as a data store

Basic Store Info

Workspace *

topp

Data Source Name *

Description

Enabled

Connection Parameters

Directory of shapefiles *

file:data/example.extension

DBF files charset

ISO-8859-1

Create spatial index if missing

Use memory mapped buffers

Cache and reuse memory maps

Save Cancel

Directory of shapefiles

Data directory release/ data/ taz_shape/

Name	Last modified	Size
tasmania_cities.shp	23-ago-2010 10.21	164
tasmania_roads.shp	23-ago-2010 10.21	8,3K
tasmania_state_boundaries.shp	23-ago-2010 10.21	6,6K
tasmania_water_bodies.shp	23-ago-2010 10.21	9K

OK Cancel

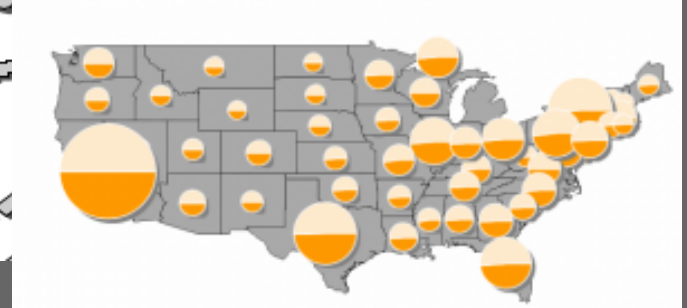
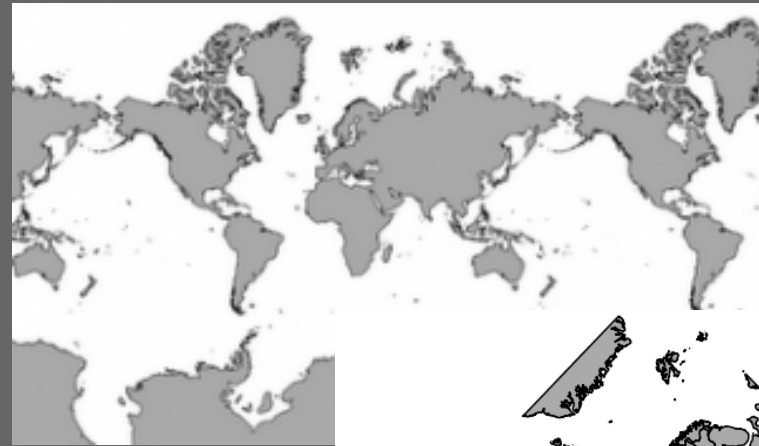
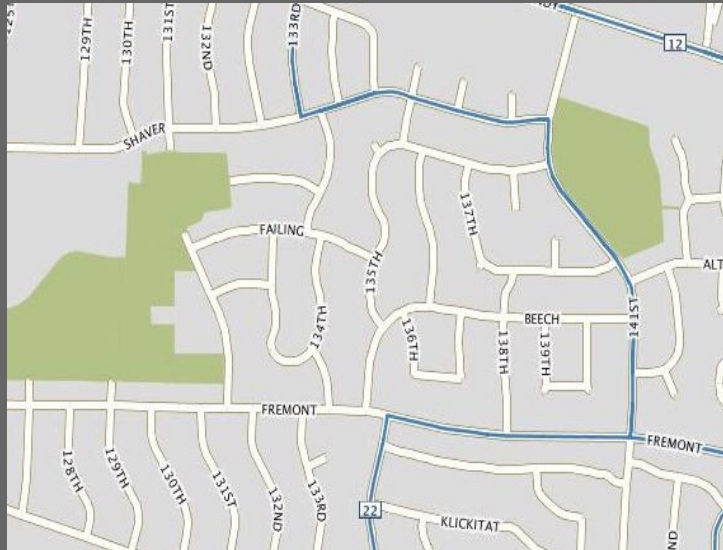
RESTful Configuration

- **Programmatic configuration of layers via REST calls**
 - Workspaces, Data stores / coverage stores
 - Layers and Styles, Service configurations
 - Freemarker templates (incoming)
- **Exposing internal configuration to remote clients**
 - Ajax - JavaScript friendly
- **Various client libraries available in different languages (Java, Python, Ruby, ...).**
- **Example, geoserver-manager:**
<https://github.com/geosolutions-it/geoserver-manager>

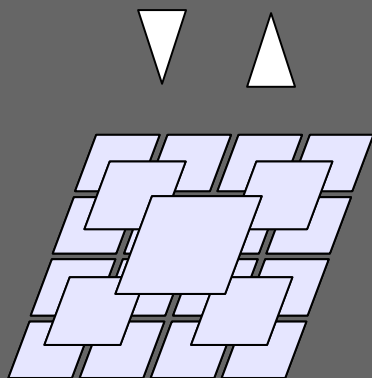
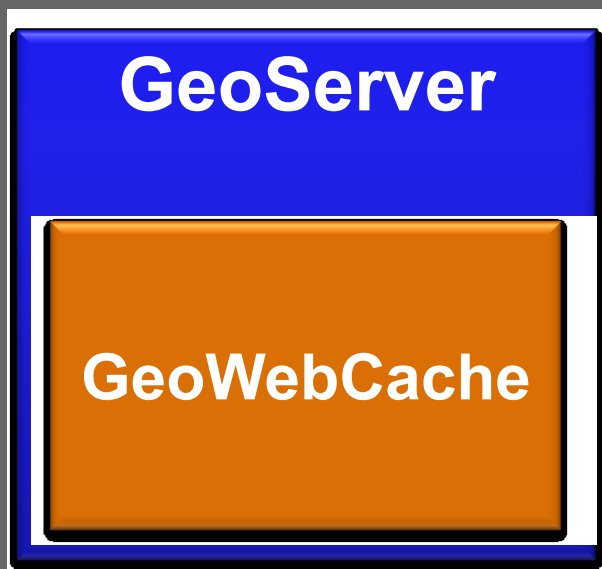
WMS

- **Dissemination of Maps**
 - Fusing raster and vector data seamlessly
 - Rule/scale driven rendering
- **WMS 1.1.1 and 1.3 support**
- **SLD**
 - Basic support for SLD 1.1 and SE 1.1
 - Full support for SLD 1.0
- **CSS extension for compact styling**
- **Many rendering extensions available**

Rendering



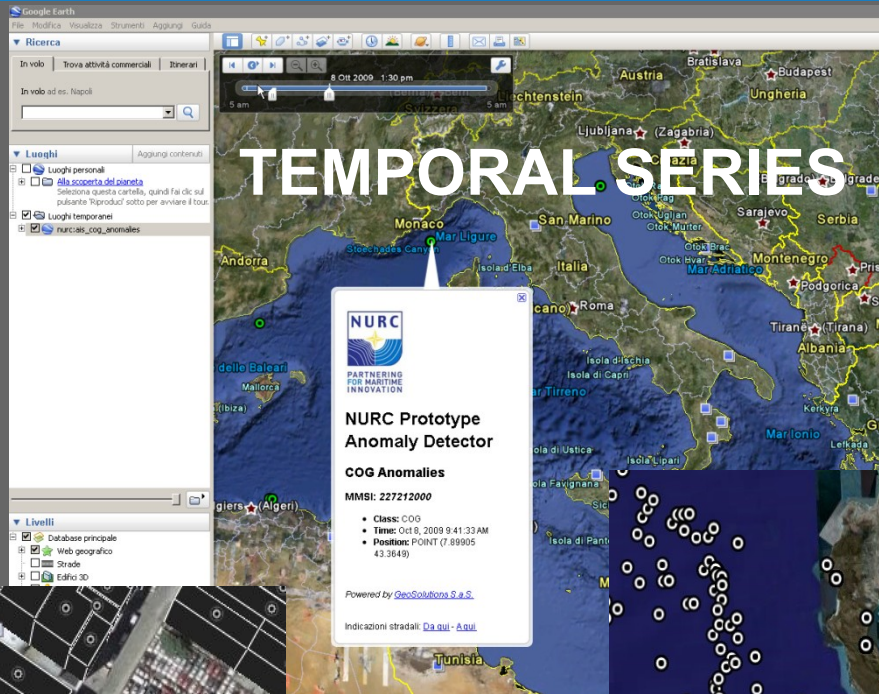
GeoWebCache Integration



Persistent raster/KML
tile cache

- Direct calls to GeoServer rendering engine
- Support for layers modified through WFS-T
- Support for various tile protocols
 - GMap, Gearth
 - OpenLayers, VEarth, Bing
- Speed-up factor 10/100
- Disk quota support

KML/KMZ



WFS

- Dissemination and filtering of vector data
- WFS 1.0, 1.1 and 2.0 (since 2.2.0)
- Transaction and paging available in all versions
- Simplified filtering via CQL
- Formats:
 - GML 2, 3.1 and 3.2
 - CSV, Excel spreadsheet, GeoRSS, GeoJSON
 - Shapefile (zipped)
 - Any other format supported by ogr2ogr (configurable)

Complex Feature*

- Application/community schemas
- Complex Features
 - Attributes as sub-features
 - Attributes as list of features
 - Tree-like structure
- Mixing in a single tree heterogeneous data sources

```

<wfs:featureCollection xmlns:wfs="http://www.opengis.net/wfs" xmlns:gml="http://www.opengis.net/gml"
xmlns:sco="http://webmap.socialchange.net/schema" maxFeatures="3">
  <gml:featureMember xmlns:gml="http://www.opengis.net/gml">
    <sco:CANRI_CATALOGUE fid="95802" xmlns:sco="http://webmap.socialchange.net/schema">
      <sco:TITLE>Bushlands data of Eastern NSW 1991 - 93 - South</sco:TITLE>
      <gml:description>The data set is a digital representation of the coarse vegetation cover in
        the eastern plains, eastern slopes and tablelands (generally the eastern division of NSW).
        The data has been visually interpreted from 1:100 000 geo-rectified Landsat TM images in
        1991/92 and then converted to grid. Spatial and classification accuracy of the data is
        consistent and of acceptable quality.</gml:description>
      <sco:RESOURCEURL/>
      <sco:TYPE>WMSLAYER</sco:TYPE>
      <sco:BEGINDATE>1991-01-01 00:00:00.0</sco:BEGINDATE>
      <sco:ENDDATE>Current</sco:ENDDATE>
      <sco:CREATOR>hfreytag</sco:CREATOR>
      <sco:CREATEDATE>2000-05-24 00:00:00.0</sco:CREATEDATE>
      <sco:PREVIEWURL/>
      <sco:METADATAHTMURL>http://canri.nsw.gov.au/nrdd/records/ANZNS0208000011.html</sco:METADATAHTMURL>
      <gml:boundedBy>
        <gml:Box>
          <gml:coordinates>140.0,-40.0 160.0,-20.0</gml:coordinates>
        </gml:Box>
      </gml:boundedBy>
      <sco:CLASSIFICATION>
        <sco:CODESPACE>ANZLIC_ID</sco:CODESPACE>
        <sco:VALUE>ANZNS0208000011</sco:VALUE>
        <sco:READABLE_TERM>ANZNS0208000011</sco:READABLE_TERM>
      </sco:CLASSIFICATION>
    </sco:CANRI_CATALOGUE>
  </gml:featureMember>
</wfs:featureCollection>

```

WCS

- **Raster data dissemination**
 - Raw raster data useful for analysis, no maps!
 - Support for TIME and ELEVATION (via ImageMosaic plugin)
- **WCS 1.0 and 1.1.1**
- **Output formats**
 - GeoTiff, ArcGrid
 - GDAL based formats under discussion
- **Extensions**
 - ELEVATION as band management

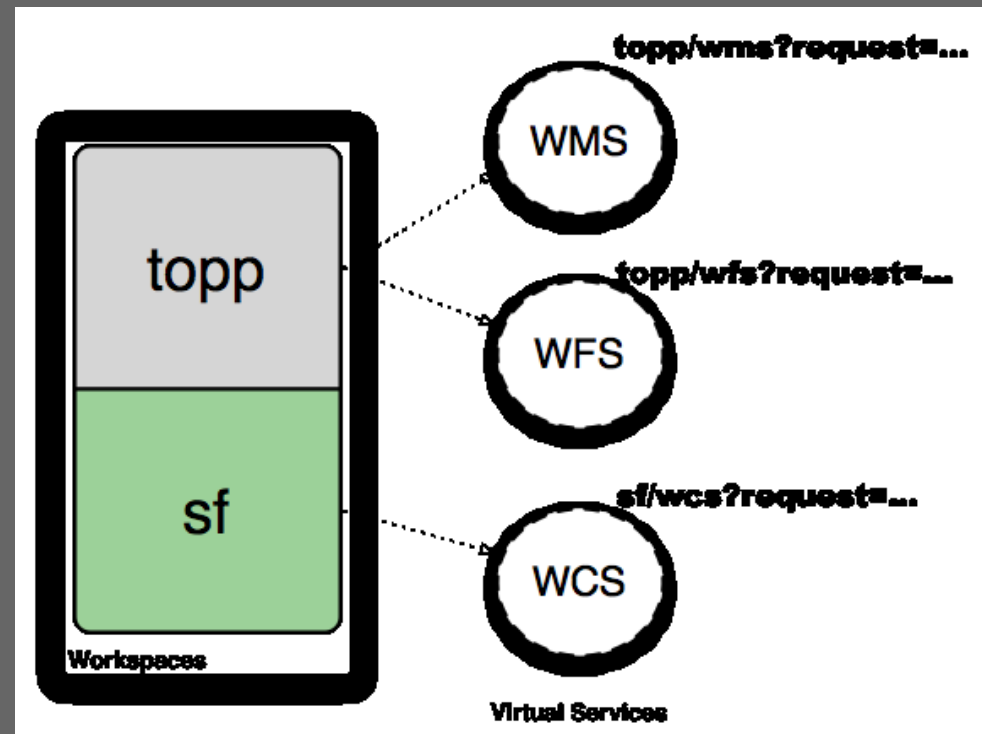
WPS

- **WPS 1.0**
- **Official Extension**
- **Raster and Vector data support**
- **High performance processes (raster/vector statistics, raster/vector format conversions and more)**
- **Integrated WPS**
 - **Direct access to data sources**
 - **Automatic publishing of results as new layers**
 - **Embedding processes into SLD styles (rendering transformation, since 2.2.0)**

What's new in 2.2.x

Virtual services

- Expose different OGC services per workspace
- Styles and layer groups per workspace
- Have different administrators per workspace
→ multi-tenancy



Referencing news

- Support for NTV2 and NADCON grids → high accuracy datum transformations
- Test and inspect re-projection interactively:

Reprojection console
Simple coordinate reprojection tool

Source CRS
EPSG:4326 EPSG:WGS 84...

Target CRS
EPSG:32632 EPSG:WGS 84 / UTM zone 32N...

[Show transformation details](#)

Source Geometry (x y, or a WKT geometry)
12 46

[Forward Transform \(source to target\)](#)

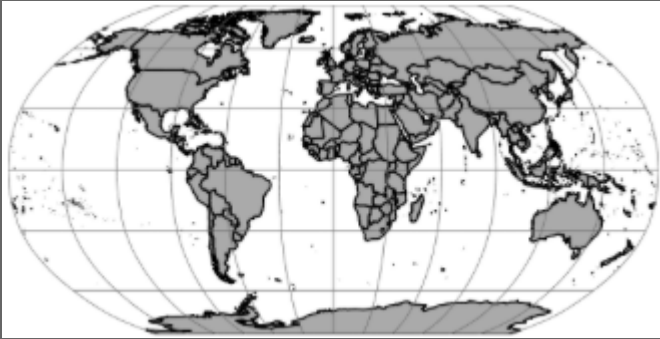
Target Point (x y, or a WKT geometry)
732293.358481655 5098424.079644502

[Backward Transform \(target to source\)](#)

EPSG:4326 -> EPSG:32632

```
PARAM_MT["Transverse_Mercator",  
PARAMETER["semi_major", 6378137.0],  
PARAMETER["semi_minor", 6356752.314245179],  
PARAMETER["central_meridian", 9.0],  
PARAMETER["latitude_of_origin", 0.0],  
PARAMETER["scale_factor", 0.9996],  
PARAMETER["false_easting", 500000.0],  
PARAMETER["false_northing", 0.0]]
```

More Projections



Robinson



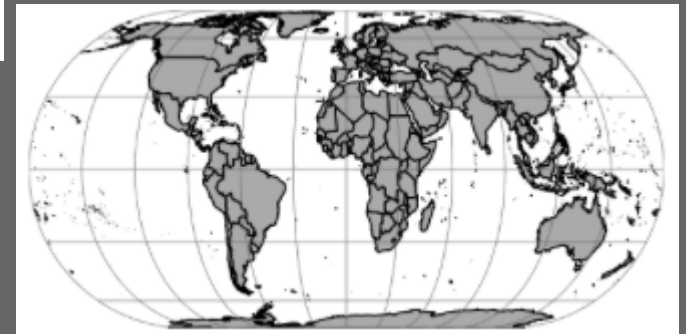
Mollweide



Winkel Tripel



Winkel Tripel



Eckert IV

Advanced Projection Handling



Management of dateline
Change and
map-wrapping



Cutting un-reprojectable
geometries

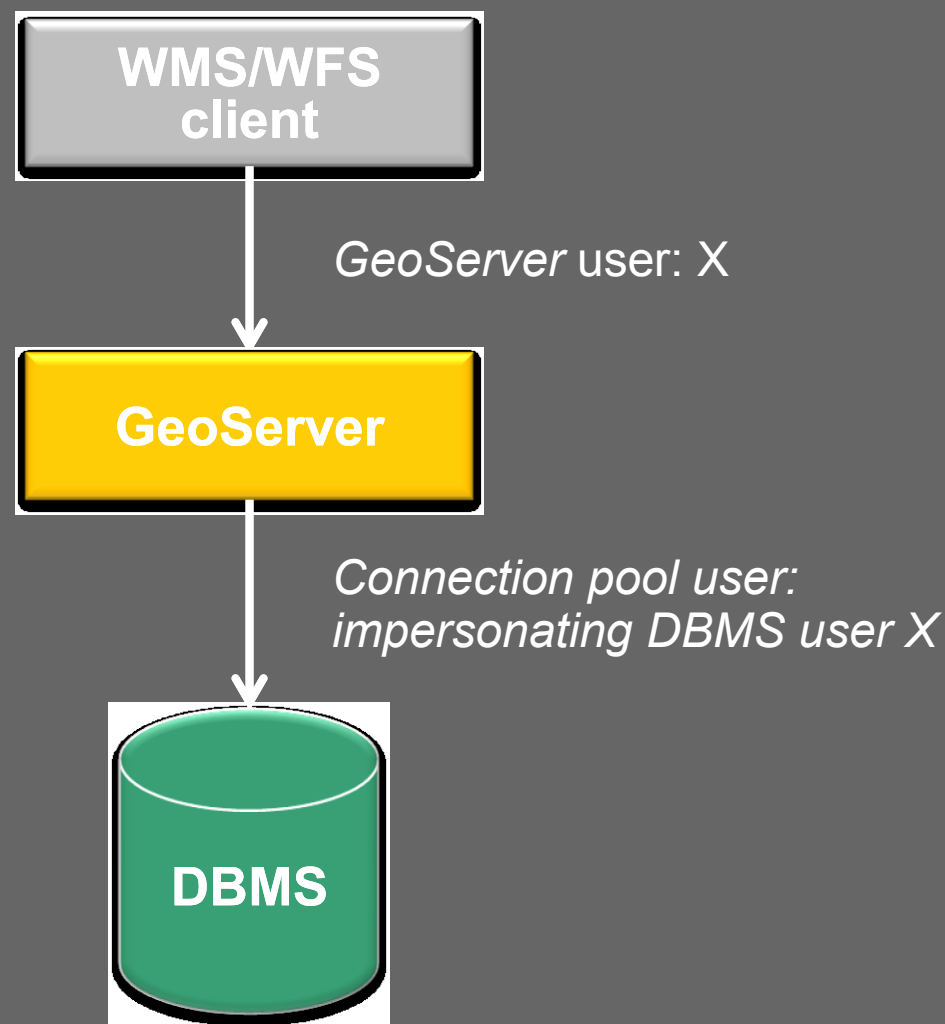
Rendering: real world units



```
<Rule>  
  <LineStyleSymbolizer uom="http://www.opengespatial.org/se/units/metre">  
    <Stroke>  
      <CssParameter name="stroke-width">  
        <ogc:Literal>5</ogc:Literal>  
      </CssParameter>  
    </Stroke>  
  </LineStyleSymbolizer>  
</Rule>
```

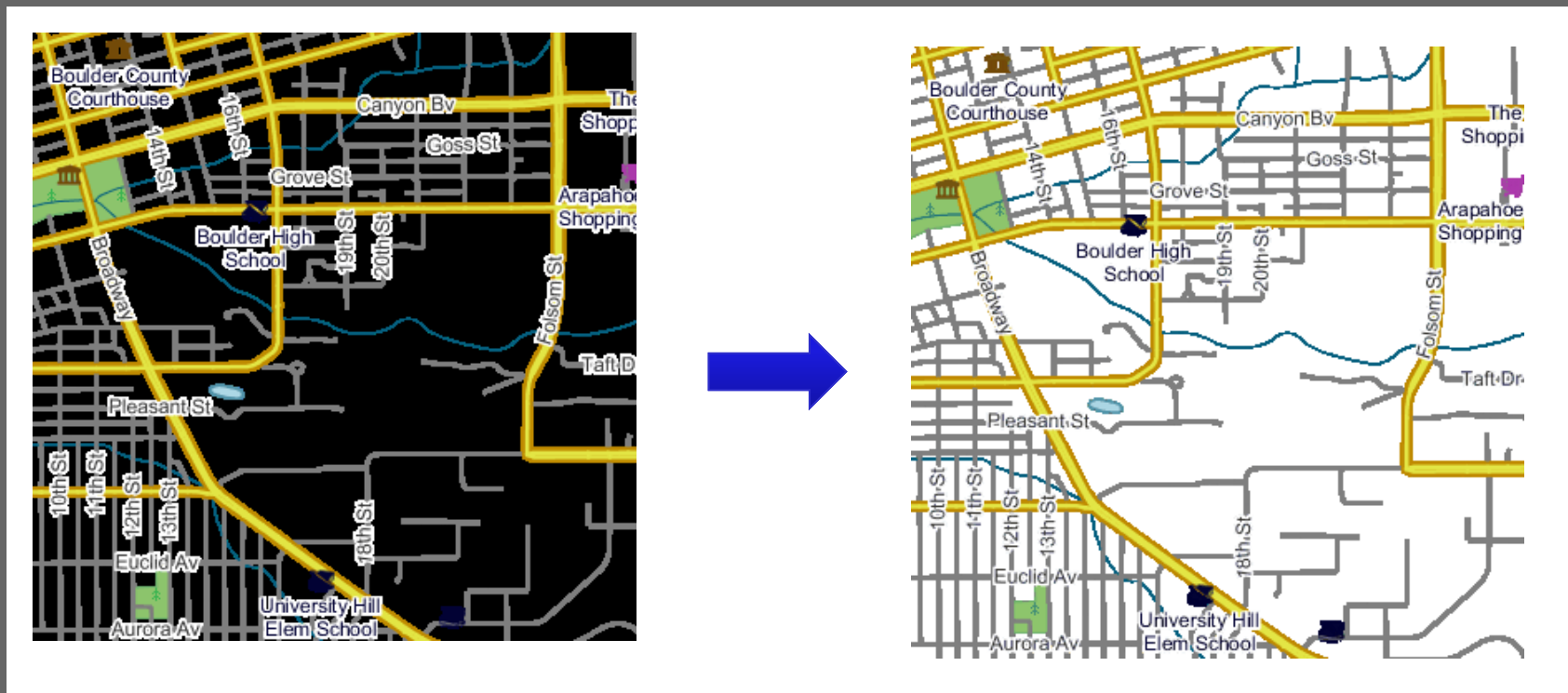
Impersonation in data access

- Use the current GeoServer user to access DBMS contents
- Tighten security also at the DBMS level
- Useful for high security setups



WMS: PNG8 with alpha

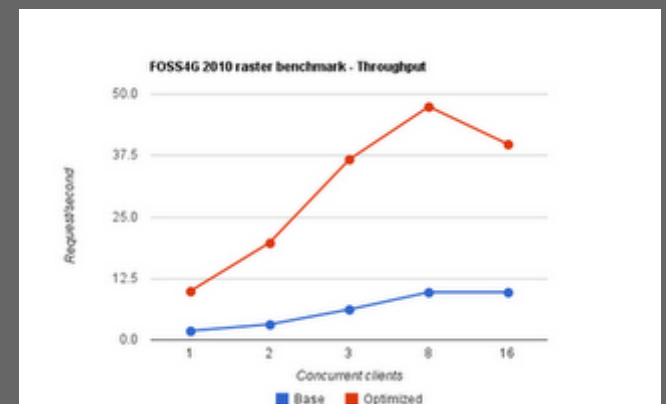
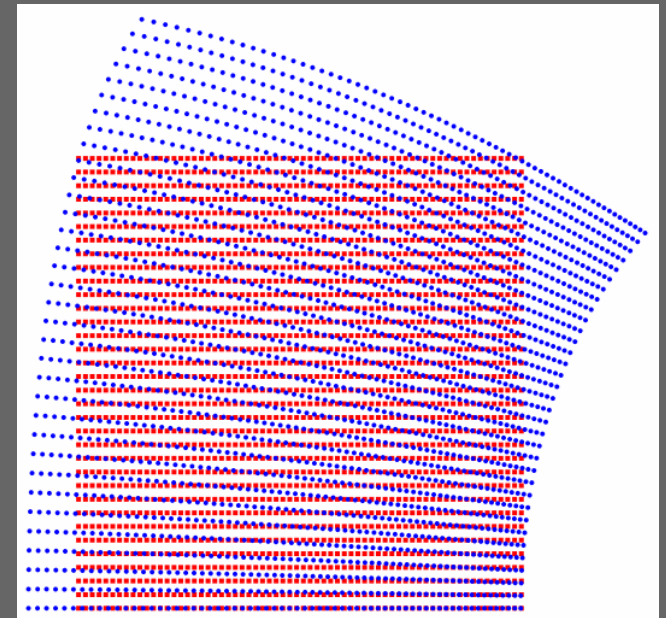
- Support for paletted PNG with alpha transparency
- Best of both worlds: compact but good looking
- Good quality, yet usable in interactive setups



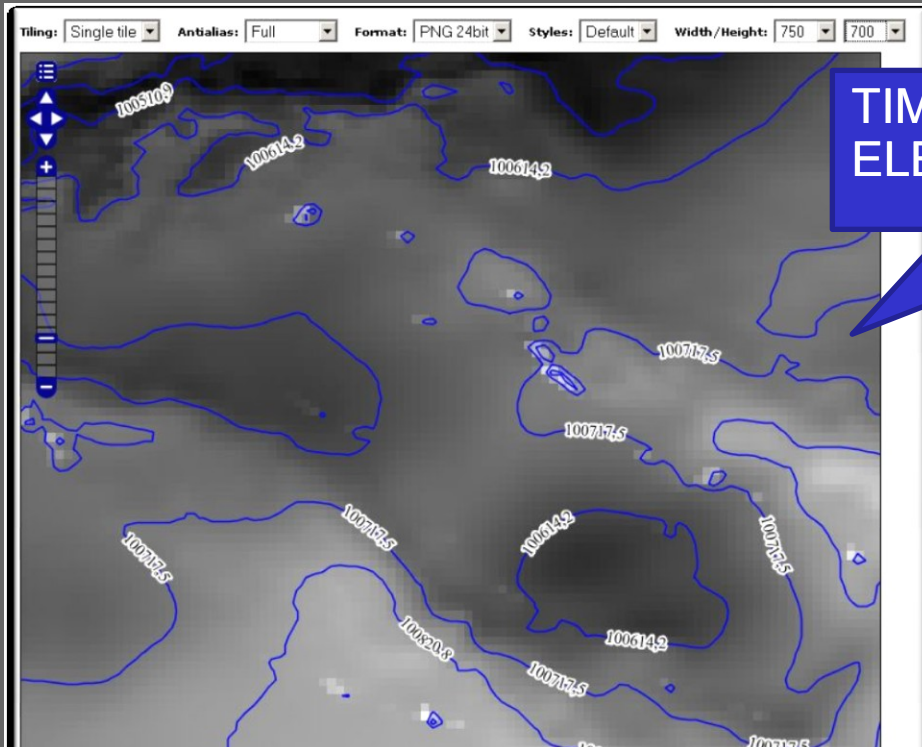
Improved Raster Reprojection



- Raster reprojection → complex process
- Idea:
 - *try to approximate the overall transformation with a simpler one, either a single affine transformation or a piecewise composition of them (grid warp)*
- Ability to specify threshold for error acceptance
- Iterative approach (local optimization)
- Trade off between speed and precision



WMS: TIME and ELEVATION



TIME = 20100512T000000Z
ELEVATION = 0.0

Bounding Boxes
Native Bounding Box

Max X	21.96
Max Y	49.721
Min X	0.04
Min Y	34.96

Complete from Native Bounding Boxes

Dimensions

TIME Dimension Attribute

ELEVATION Dimension Attribute

Feature Type Details

Property	Type	Nullable	Min/Max Occurrences
the_geom	MultiLineString	true	0/1
elevation	Double	true	0/1
elev	Double	true	0/1
basetime	Timestamp	true	0/1
runtime	Integer	true	0/1

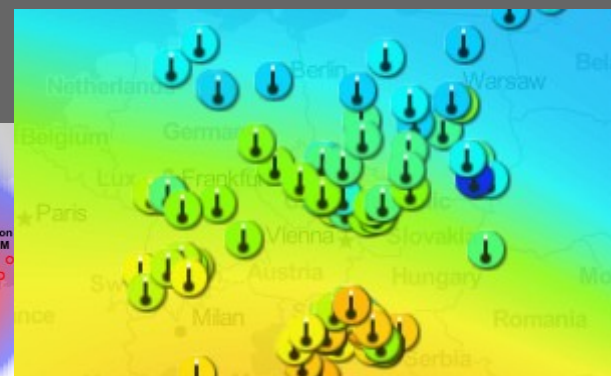
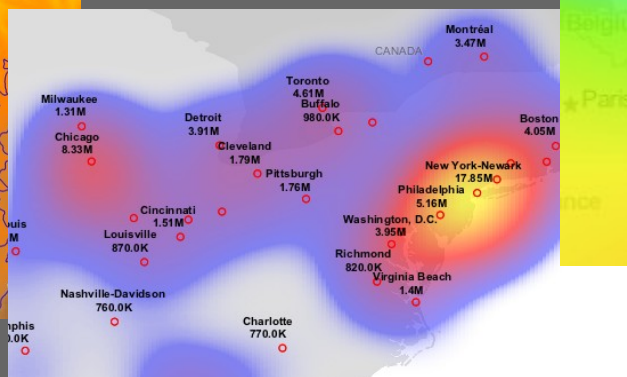
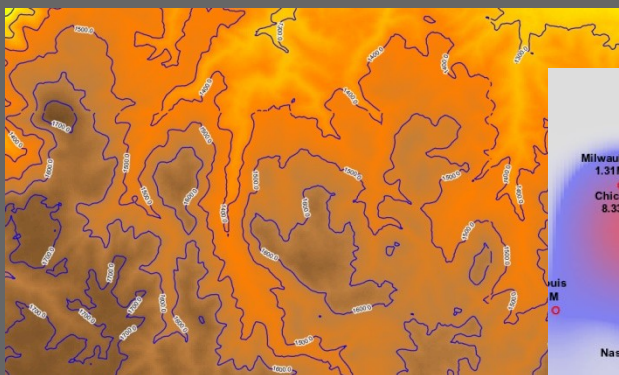
FeatureType Editor

```

<Layer queryable="1">
  <Name>it.geosolutions:Pressure_reduced_to_MSL_contour</Name>
  <Title>Pressure_reduced_to_MSL_contour</Title>
  ...
  <LatLonBoundingBox minx="0.04" miny="34.96" maxx="21.96" maxy="49.721"/>
  <BoundingBox SRS="EPSG:4326" minx="0.04" miny="34.96" maxx="21.96" maxy="49.721"/>
  <Dimension name="time" units="ISO8601"/>
  <Dimension name="elevation" units="EPSG:5030"/>
  <Extent name="time" default="current">2010-05-12T00:00:00.000Z</Extent>
  <Extent name="elevation" default="0.0">0.0</Extent>
  
```

WMS: Rendering Transformations

- On-the-fly data transformations
- Calling spatial analysis processes from SLD docs
- Optimized for performance
- Examples: on the fly contour lines, heat maps, point clustering, point interpolation, GCP based image rectification



Improved GWC integration

Edit Layer

Edit layer data and publishing

topp:tasmania_roads

Configure the resource and publishing information for this layer

Data Publishing Dimensions **Tile Caching**

Tile cache configuration

- Create a cached layer for this layer
- Enable tile caching for this layer

Metatiling factors

4 tiles wide by 4 tiles high

Gutter size in pixels

0

Tile Image Formats

- image/png
- image/png8
- image/jpeg
- image/gif

Parameter Filters

- Create a separate cache for each STYLE
- Create a separate cache for the TIME WMS parameter
- Create a separate cache for the ELEVATION WMS parameter

Available gridsets

Gridset	Published zoom levels	Cached zoom levels	Grid subset bounds
EPSG:4326	Min / Max	Min / Max	Dynamic
EPSG:900913	Min / Max	Min / Max	Dynamic

Add grid subset: Scegliere uno

Gridsets

Manage the available gridsets or create a new one

- [Create a new gridset](#)
- [Remove selected gridsets](#)

Results 1 to 5 (out of 5 items)

Gridset	CRS	Tile Dimensions	Zoom levels	Disk Usage
GlobalCRS84Scale	EPSG:4326	256 x 256	21	0,0 B
EPSG:4326	EPSG:4326	256 x 256	22	0,0 B
GoogleCRS84Quad	EPSG:4326	256 x 256	19	0,0 B
EPSG:900913	EPSG:900913	256 x 256	31	0,0 B
GlobalCRS84Pixel	EPSG:4326	256 x 256	18	0,0 B

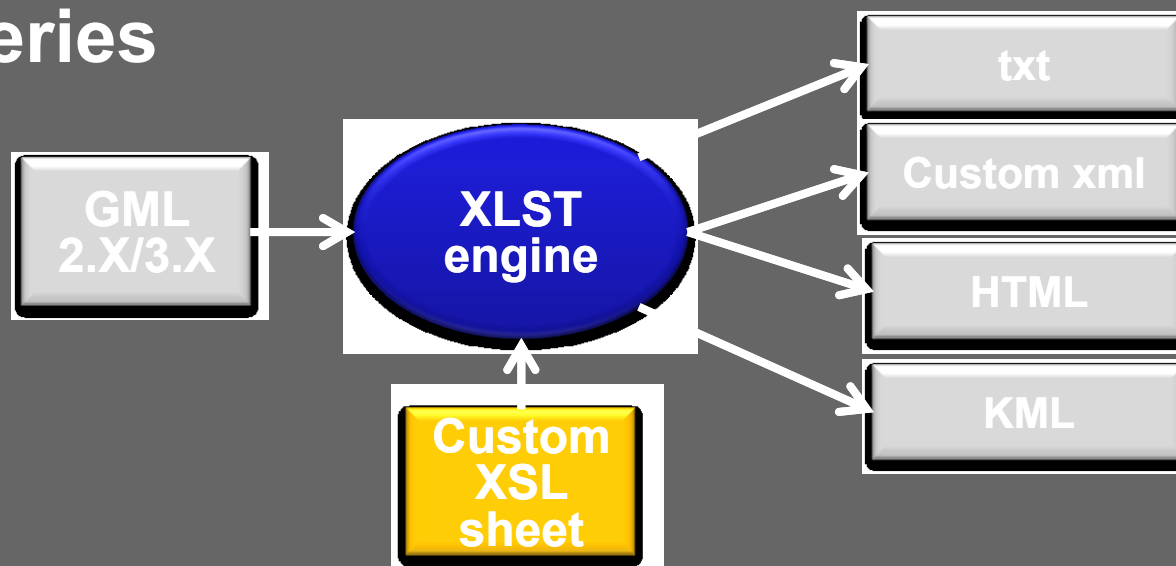
Results 1 to 5 (out of 5 items)

- Custom gridset definition

- Per layer caching configuration

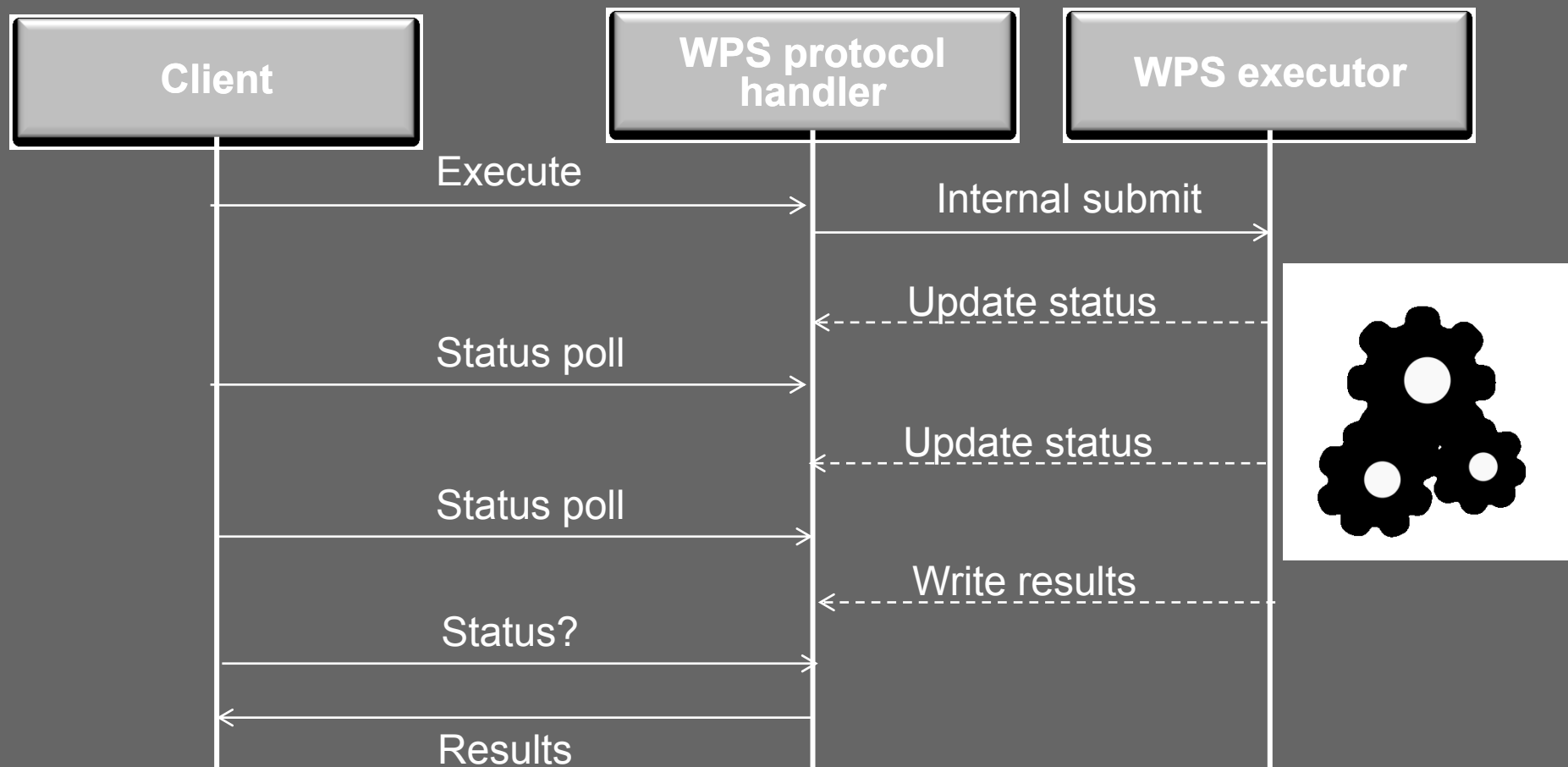
WFS: 2.0 and XSLT

- WFS 2.0
 - GML 3.2
 - Paging (back-ported to other versions)
 - Joins (scalar, temporal, spatial) between feature types
 - Stored queries
- XSLT output format:



WPS: asynchronous calls

- Asynchronous WPS support for long running processes



Security: Authentication

- Pluggable user sources, available out of the box:
 - LDAP, DBMS
- Pluggable authentication mechanisms, available out of the box:
 - BASIC/DIGEST HTTP, CAS
- Possible to integrate with other mechanisms and in-house solutions
- Available since 2.2.0, before only basic HTTP auth + simple text file for users

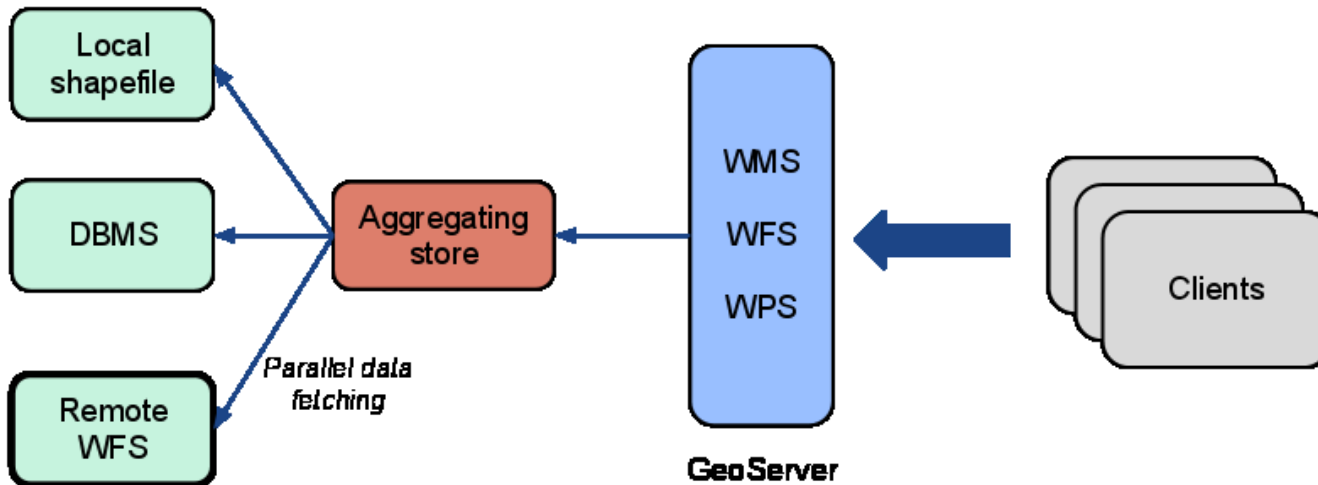
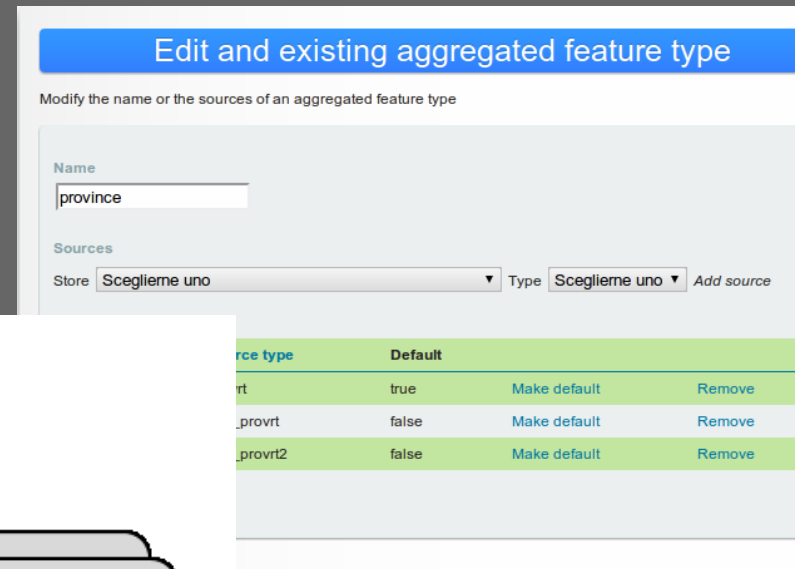
Image Server*

- Turning GeoServer into an Image Server
 - Serving pure Imagery
 - No geo-reference need/available/(would make sense!)
- Special Coordinate Reference Systems defined
 - Interoperability with WMS clients
 - Respecting EPSG conventions
 - EPSG:404000
 - See [here](#)
- Improved support for data with bad/missing geo-reference!



Aggregating data store

- N layers, remote or local, sharing the same structure
- Aggregating store puts them together dynamically, the client wil think there is just one layer
- Parallel data fetching
- Can be configured to tolerates temporarily unreachable data sources



What's new in 2.3.x

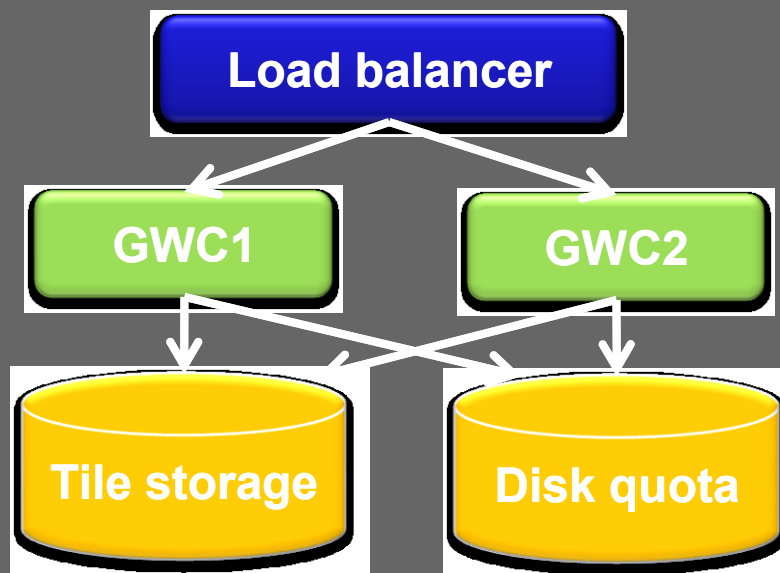
Database configuration backend

- Pluggable configuration backends
- In-memory implementation + XML storage (current one)
- Database based implementation (as a community module)
- Pluggable, add your own (any takers for a NoSQL elastic implementation?)



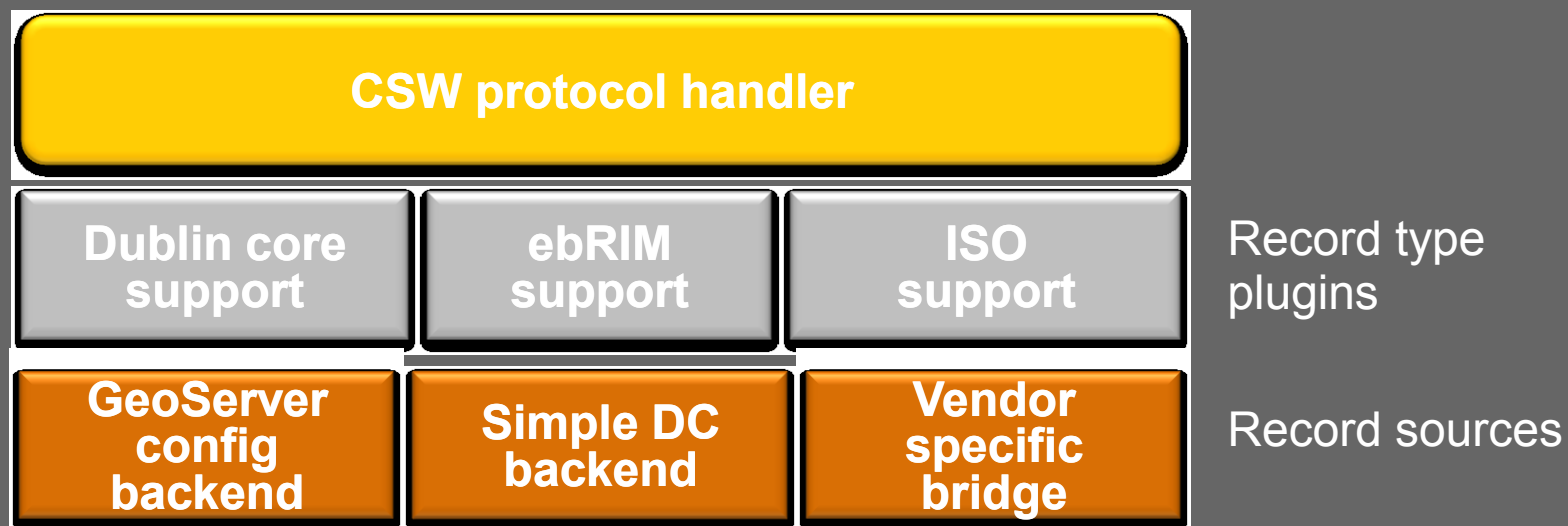
GWC clustering

- Improved clustering for GWC in 1.4.x:
 - Metastore removed
 - Disk quota can work off a central DBMS
 - Distributed locks, avoid concurrent computation of same tile at the same time
- Active/active clustering of GWC now possible



CSW 2.0.2

- **Wow, catalogue services in GeoServer!**
- **Catalog Service for the Web 2.0.2**
- **Pluggable record backend**
- **Pluggable record type support**
- **Not a replacement for a full-fledged GeoNetwork (not at the moment, at least)**



CSW 2.0.2

- **Current implementation**
 - Demo backend with Dublin Core record support, passes CITE certifications tests
 - ISO + Dublin core backend reporting layers in the GeoServer configuration, in development
 - ebRIM (Earth Observation profile) implementation plus proxy to a in-house, vendor specific catalog (proxy front-end model)
- **Currently a community module**
 - will be graduated to extension once the ISO backend over the GeoServer own config is completed

WCS 2.0

- **WCS 2.0 implementation with extensions:**
 - Range subsetting
 - Scaling and interpolation
 - CRS (reprojection)
 - GeoTiff & NetCDF encoding
- **Earth Observation profile support**
 - Temporal series
 - Exposing mosaic structure
 - EO metadata describing sensors
- **NetCDF support as both input and output**
- **Sponsors**
 - DLR (German spatial agency)
 - EUMETSAT (European operational satellite agency for monitoring weather, climate and the environment)

Layer Groups

Capabilities Tree

Generate Bounds

Mode

- ✓ Single
- Named Tree
- Container Tree**
- Earth Observation Tree

+ Add Layer...

+ Add Layer Group...

Position	Layer	Default Style
↓	ne:ne_physical	<input checked="" type="checkbox"/>
↑	ne:ne_cultural	<input checked="" type="checkbox"/>

<< < 1 > >> Results 1 to 2 (out of 2 items)

Nesting

Layers

+ Add Layer...

+ Add Layer Group...

Position	Layer	Default Style
	ne:ne_physical	<input checked="" type="checkbox"/>

<< < 1 > >> Results 1 to 2 (out of 2 items)

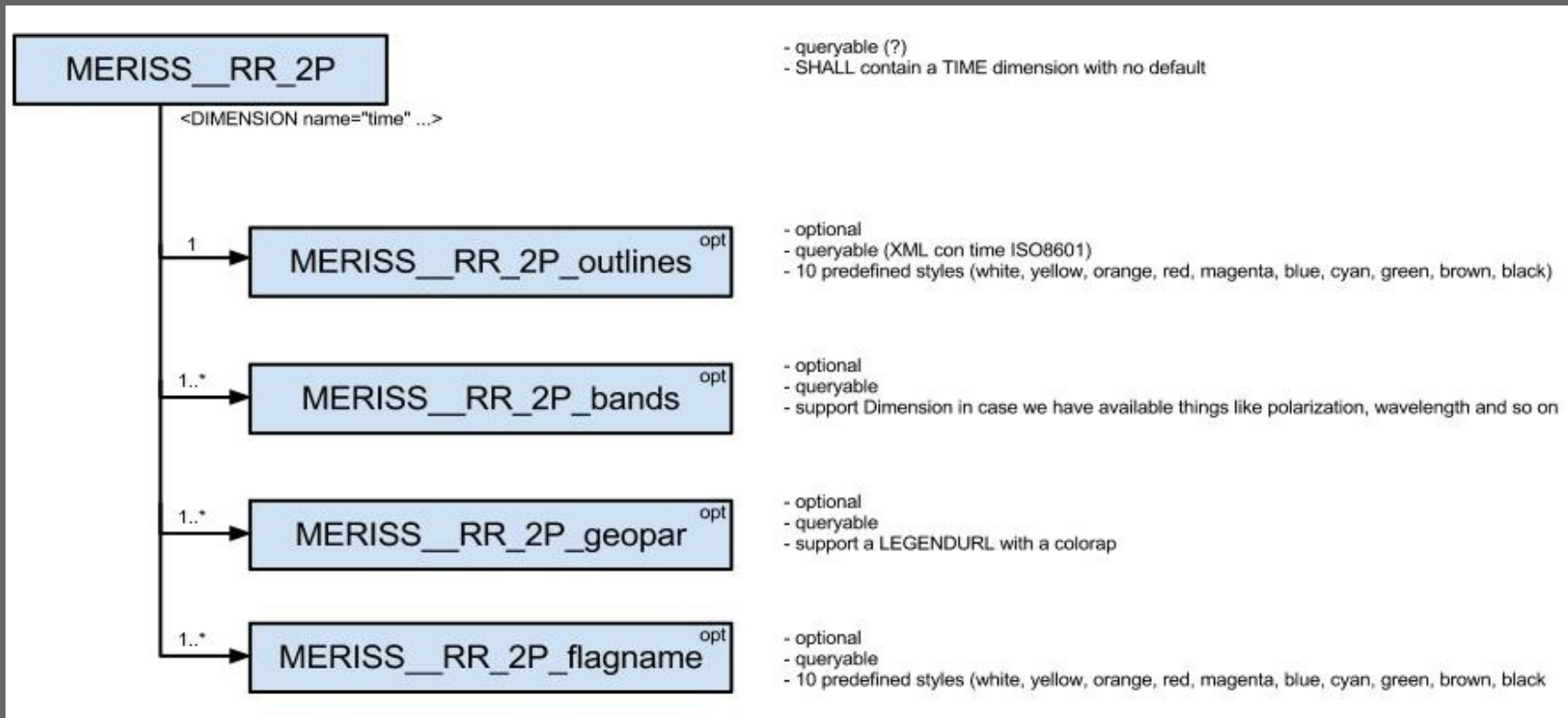
Other Enhancements

- **WPS Process Selection**
- **WMS Additional Dimensions**
- **More INSPIRE**
- **Monitoring Extension**
- **Extensive JSONP Support**
- **Security Subsystem Improvements**

**What's cooking for 2.4.x
(plus wish list 😊)**

WMS EO

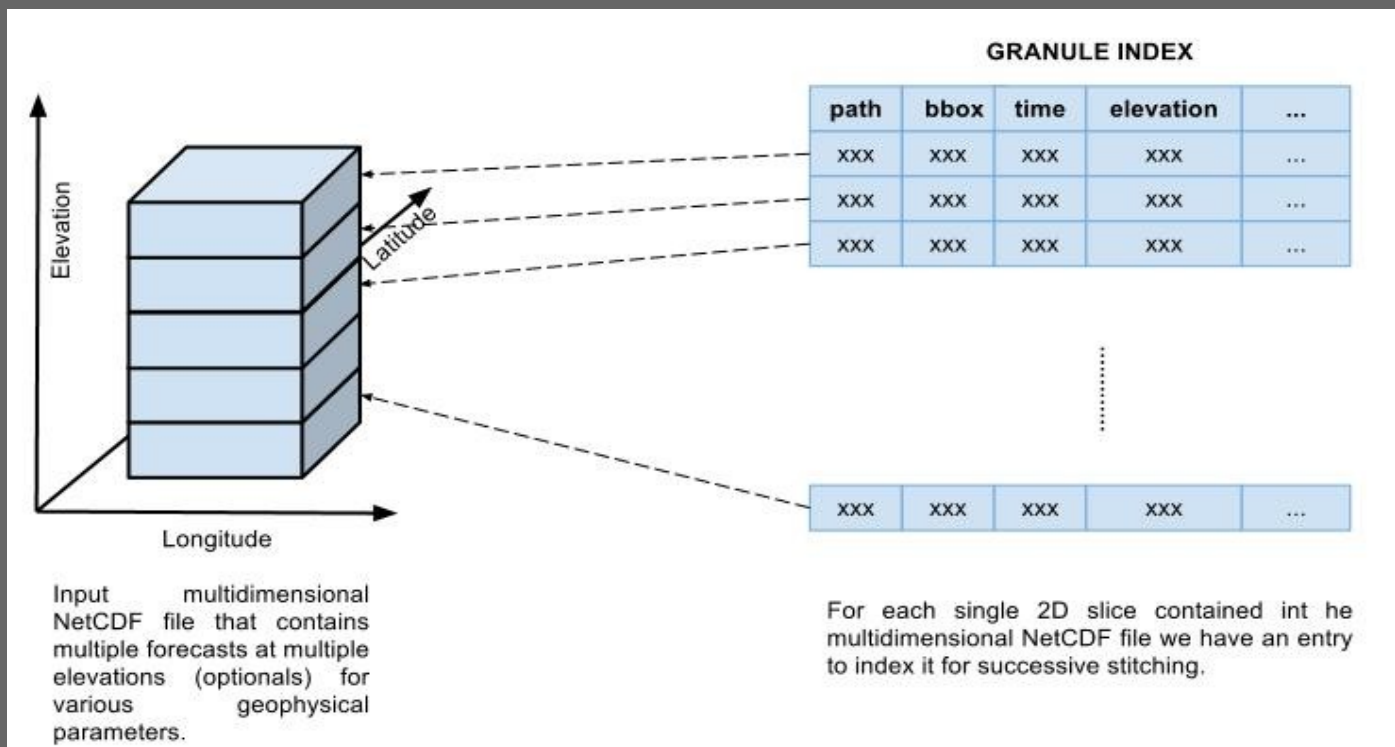
- Earth Observation profile support
 - Temporal series
 - Exposing mosaic structure
 - EO metadata describing sensors



Spatiotemporal Raster Management

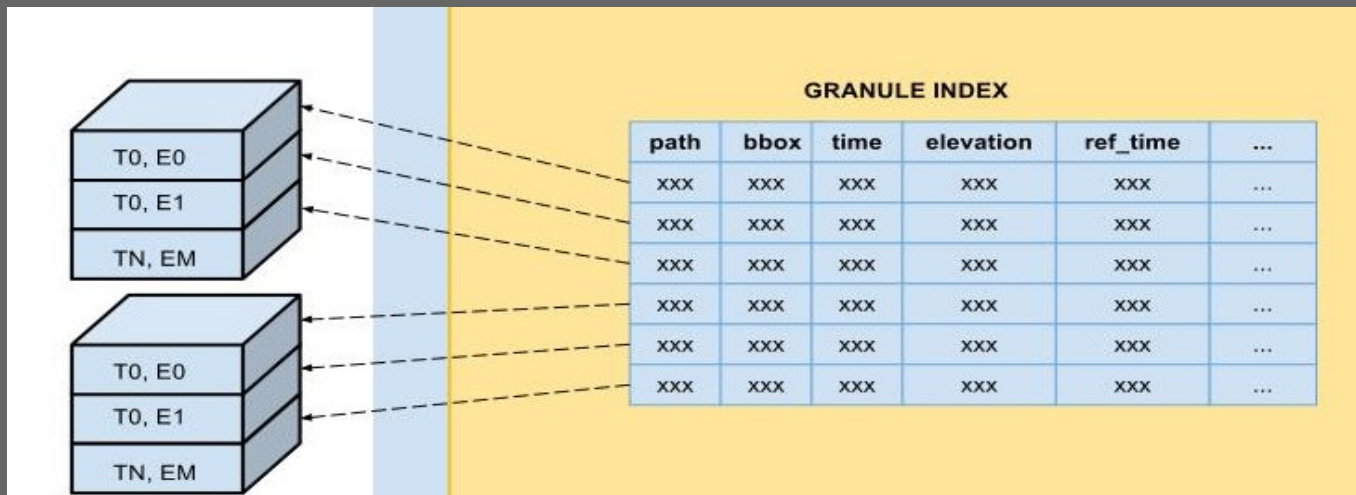
- **NetCDF support**

- Improve existing NetCDF/CF input format, support CF convention and make sure the samples provided by DLR/EUMETSAT can be read
- Expose NetCDF internal data as a set of 2D slices
- Write new NetCDF/CF output format for GeoServer



Spatiotemporal Raster Management

- Add REST support to expose a image mosaic internal structure
 - Dimensions
 - Granules
- **Dimensions: list, edit, create, remove**
 - `/workspaces/<ws>/coveragestores/<cs>/coverages/<mosaic>/dimensions`
 - `/workspaces/<ws>/coveragestores/<cs>/coverages/<mosaic>/dimensions/<dimension>[.format]`
 - **TODO** paging and query of dimension domain
- **Granules: list, edit, create, remove**
 - `/workspaces/<ws>/coveragestores/<cs>/coverages/<mosaic>/index`
 - `/workspaces/<ws>/coveragestores/<cs>/coverages/<mosaic>/index/pageN`
 - `/workspaces/<ws>/coveragestores/<cs>/coverages/<mosaic>/index/pageN/granuleM`



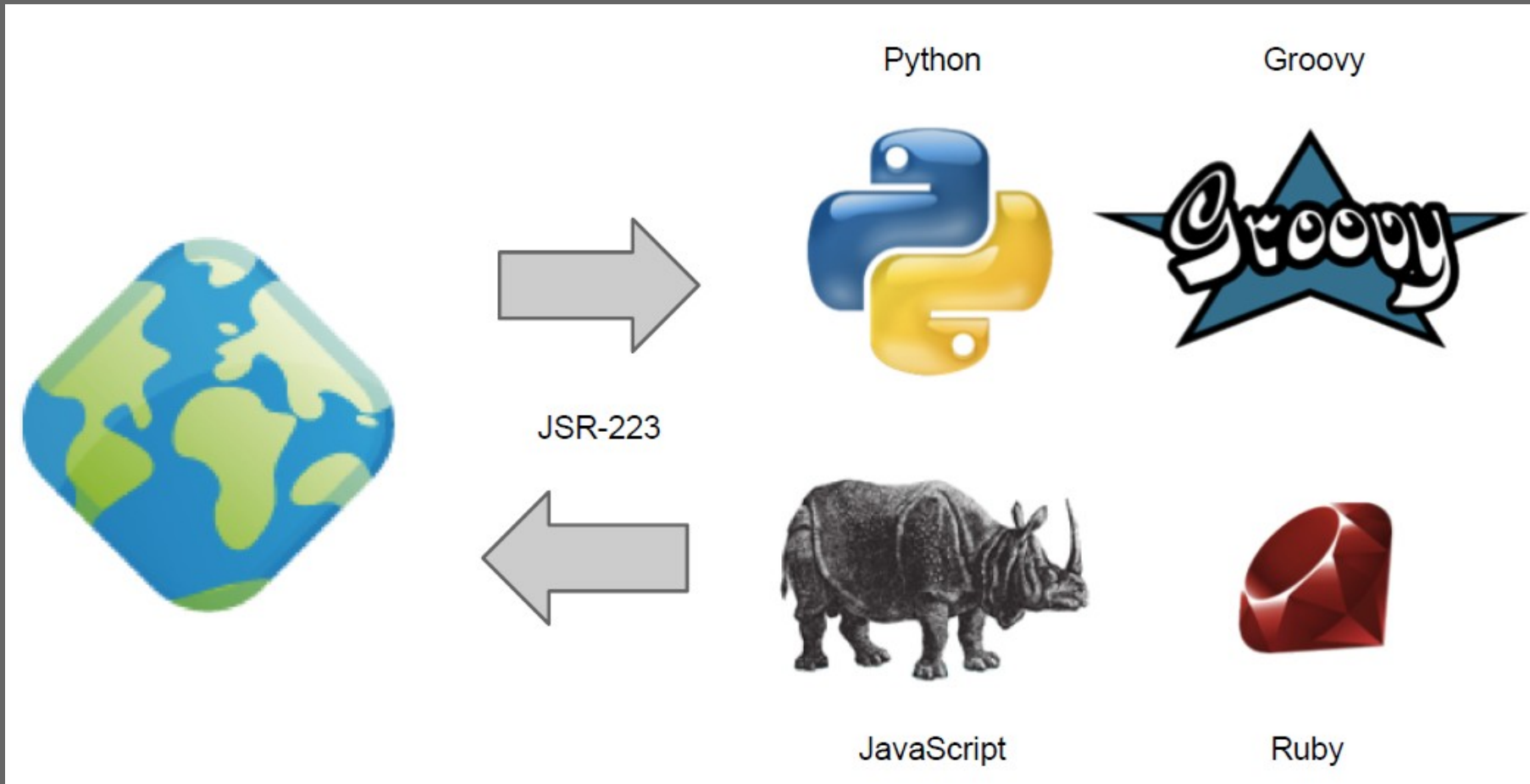
Importer

- Graphical Workflow for preprocessing data
- Copy over, optimize, publish and style

The screenshots illustrate the following steps in the GeoServer Importer workflow:

- Importa una directory:** Selecting a workspace (e.g., 'geosolutions') and providing a name and description for the directory.
- Importa dei GeoTIFF:** Configuring import parameters such as SRS (EPSG:4326), compression type (NONE), and ratio (75%). A file selection dialog is shown for choosing the directory to import from.
- Crea una connessione PostGIS:** Establishing a connection to a PostGIS database, including workspace selection and connection parameters.
- Parametri di connessione:** Finalizing the connection configuration.

Scripting Processing (WPS)



More...

- QGIS Integration
- Vector Data Attribute Remapping
- Advanced Authorization Subsystem
- Circular Arc Support

The End



Questions?

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