Basic Cartography for SDI (WMS and SLD)

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What Does an SDI Means in practice?

- Common Exchange (of Geoinformation / Geoservices)

- Common Exchange = **Interoperability**

- Interoperability = **(Geospatial) Standards**

- (Geospatial) Standards = Open Geospatial Consortium – OGC (+ INSPIRE)

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Interoperability

- Interoperability, at a technical level, refers to the ability of a system to provide information portability and inter-application as well as cooperative process control.

- Interoperability, in the context of the OGC, is **software components operating reciprocally** (working with each other) to **overcome import/export obstacles and distributed resource access barriers** imposed by heterogeneous processing environments and heterogeneous data sources.

Service-Oriented Cartography in a Nutshell
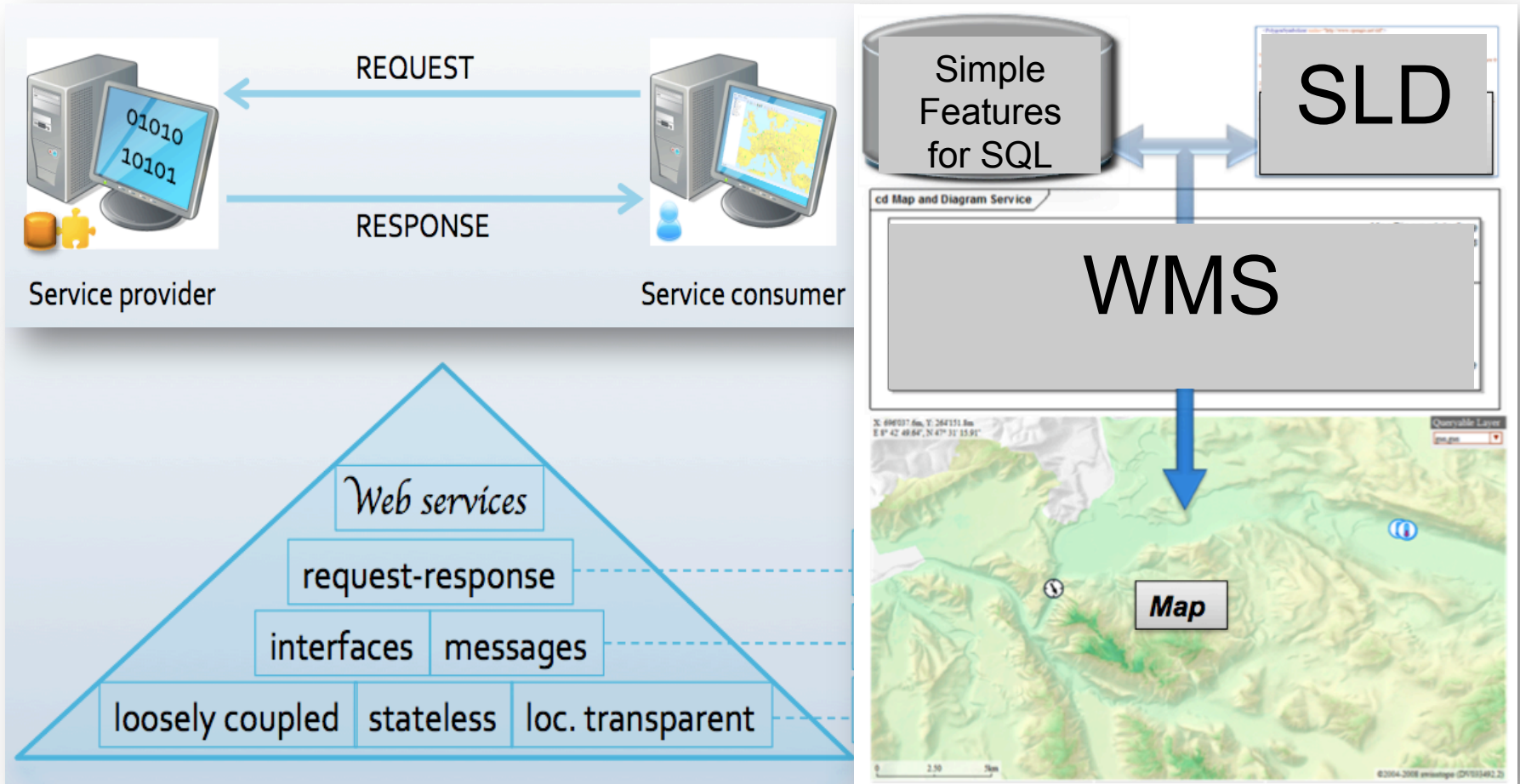
Relevant OGC Standards for Cartography (1)

- **Web Map Service (WMS)**
- Web Feature Service (WFS)
- Web Coverage Service (WCS)
- Simple Features (SFO, SFS, SFC)
- Geography Markup Language (GML 3.0)
- **Styled Layer Descriptor (SLD)**
- **Symbology Encoding (SE)**
- **Filter Encoding (FE)**

Relevant OGC Standards for Cartography (2)

- **WMS** - Provides three operations protocols (GetCapabilities, GetMap, and GetFeatureInfo) in support of the creation and display of registered and superimposed map-like views of information that come from multiple sources and that are both remote and heterogeneous.

- WFS - The purpose of the Web Feature Server Interface Specification (WFS) is to describe data manipulation operations on OpenGIS® Simple Features (feature instances) such that servers and clients can "communicate" at the feature level

- WCS - Extends the Web Map Server (WMS) interface to allow access to geospatial "coverages" that represent values or properties of geographic locations, rather than WMS generated maps (pictures).

Relevant OGC Standards for Cartography (3)

- Simple Features - Provides application programming interfaces (APIs) for publishing, storage, access and simple operations on Simple Features (point, line, polygon, multi-point, etc).

- GML - Is an XML encoding for the transport and storage of geographic information, including both the geometry and properties of geographic features.

- **SLD - Is an XML encoding for extending the Web Map Server specification with user-defined symbolization (uses SE & FE).**

- SE - The SE is an XML language for styling information (distilled from the original SLD specification).

- FE - A filter is a construct used to describe constraints on properties of a feature class for the purpose of identifying a subset of feature instances to be operated upon in some way.

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Web Map Service – WMS 1.3.0 / ISO 19128

- Open standard for visualization of raster and vector data
- Distributed maps over the Web
  - Communication protocol: HTTP
- Implementable with many technologies
  - CGI (Common Gateway Interface) - passes the request parameters to the server
  - Java Servlets, JSP (Java Server Pages), Python, ...
- Output: Web formats (JPEG, PNG, GIF, SVG)
- Symbolization control using SLD (+SE,FE, …)
- Free and open source (FOSS) & proprietary implementations:
  - UMN mapserver, Geoserver, QGIS mapserver, ESRI ArcGIS Server

WMS - Operations

- ## GetCapabilities
  - Returns a Capabilities description

- ## GetMap
  - Generates and returns the requested map

- ## GetFeatureInfo (optional)
  - Queries features inside the map

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WMS – GetCapabilities Request

Request Parameter	Mandatory/ Optional	Description
VERSION=version	O	Request version
SERVICE=WMS	M	Service type
REQUEST=GetCapabilities	M	Request name
FORMAT=MIME_type	O	Output format of service metadata
UPDATESEQUENCE=string	O	Sequence number or string for cache control

- Response:
  - WMS Capabilites Instance Document (capabilities description in XML)
  - Contains service metadata (general information, operations, layers, coordinate reference systems,…)

WMS – GetMap Request

Request Parameter	Mandatory/ Optional	Description
VERSION=1.3.0	M	Request version.
REQUEST=GetMap	M	Request name.
LAYERS=layer_list	M	Comma-separated list of one or more map layers.
STYLES=style_list	M	Comma-separated list of one rendering style per requested layer.
CRS=namespace:identifier	M	Coordinate reference system.
BBOX=minx,miny,maxx,maxy	M	Bounding box corners (lower left, upper right) in CRS units.
WIDTH=output_width	M	Width in pixels of map picture.
HEIGHT=output_height	M	Height in pixels of map picture.
FORMAT=output_format	M	Output format of map.
TRANSPARENT=TRUE|FALSE	O	Background transparency of map (default=FALSE).
BGCOLOR=color_value	O	Hexadecimal red-green-blue color value for the background color (default=0xFFFFFF).
EXCEPTIONS=exception_format	O	The format in which exceptions are to be reported by the WMS (default=XML).
TIME=time	O	Time value of layer desired.
ELEVATION=elevation	O	Elevation of layer desired.
Other sample dimension(s)	O	Value of other dimensions as appropriate.

WMS 1.3.0 vs. 1.1.1 – BBOX Parameter for Geographical Coordinates

- In general, for Cartesian reference systems BBOX is expressed as "xmin,ymin,xmax,ymax".

- The WMS specification for WMS 1.3.0 specifies that for geographical coordinate systems, the order of the BBOX coordinates is "latMin,longMin,latMax,longMax".

- In contrast, WMS 1.1.1 used longMin, latMin, longMax, latMax for geographic CRS.

- Difference between WMS 1.1.1 and WMS 1.3.0 in expressing the BBOX for geographical coordinate reference systems!

WMS – GetFeatureInfo Request

Request Parameter	Mandatory/ Optional	Description
VERSION=1.3.0	M	Request version.
REQUEST=GetFeatureInfo	M	Request name.
map request part	M	Partial copy of the Map request parameters that generated the map for which information is desired.
QUERY_LAYERS=layer_list	M	Comma-separated list of one or more layers to be queried.
INFO_FORMAT=output_format	M	Return format of feature information (MIME type).
FEATURE_COUNT=number	O	Number of features about which to return information (default=1).
I=pixel_column	M	i coordinate in pixels of feature in Map CS.
J=pixel_row	M	j coordinate in pixels of feature in Map CS.
EXCEPTIONS=exception_format	O	The format in which exceptions are to be reported by the WMS (default= XML).

Styled Layer Descriptor - SLD

- Additional standard to WMS
- Controls the map (layer) symbolization by:
  - Named Styles (for NamedLayers)
  - User Styles (for NamedLayers and UserLayers)
- User Styles
  - Hierarchical structure (XML)
- Rules include FE and SE:
  - Filters for Features
  - Symbolizers (Line, Polygon, Point, Text, Raster)
- A WMS GetMap request with user-defined symbolization has an additional parameter, either SLD or SLD_BODY

SLD by Example: NamedLayers and NamedStyles (General Structure)

```xml
<sld:StyledLayerDescriptor xmlns:sld="http://www.opengis.net/sld"
xmlns:ogc="http://www.opengis.net/ogc">
    <sld:NamedLayer>
        <sld:Name>eu_rivers</sld:Name>
        <sld:NamedStyle>
            <sld:Name>default</sld:Name>
        </sld:NamedStyle>
    </sld:NamedLayer>
</sld:StyledLayerDescriptor>
```

SLD by Example: Point Symbolizer (Mark)

```xml
<PointSymbolizer>
    <Graphic>
        <Mark>
            <WellKnownName>square</WellKnownName>
            <Fill>
                <CssParameter name="fill">#ffff00</CssParameter>
            </Fill>
        </Mark>
        <Size>6</Size>
    </Graphic>
</PointSymbolizer>
```
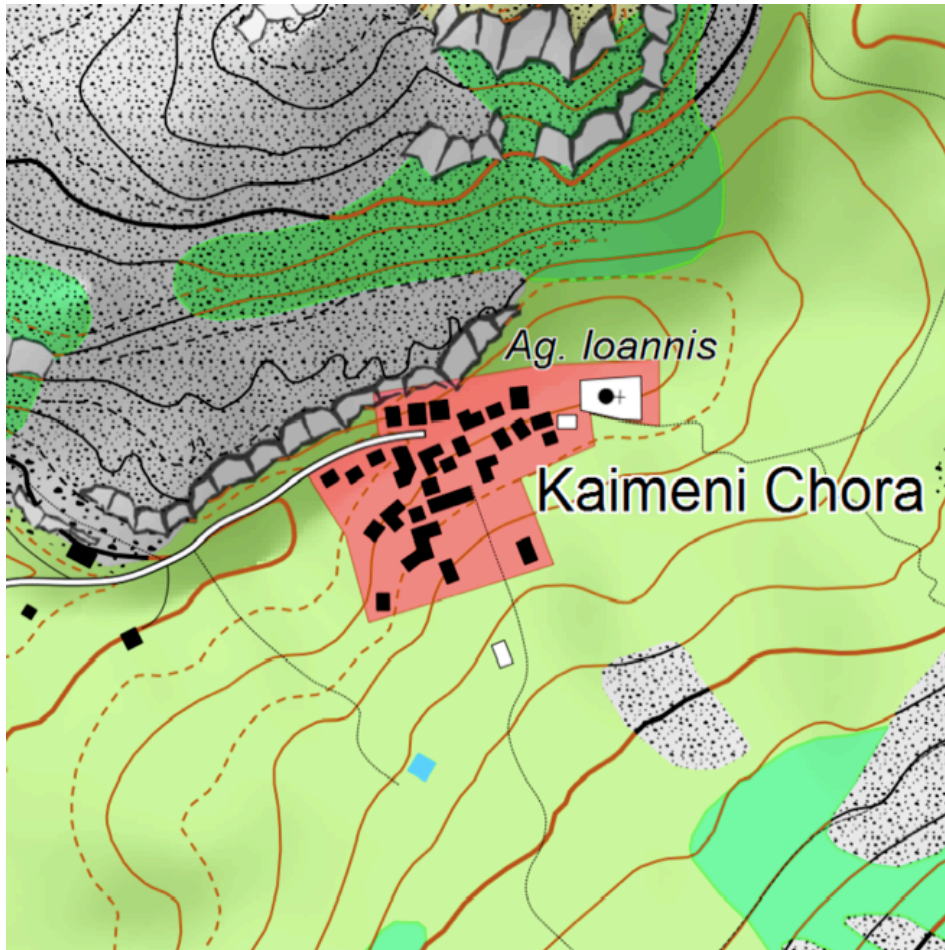
SLD by Example: Rules and Line Symbolizer (Stroke)

```xml
<Name>blue</Name>
<FeatureTypeStyle>
 <Rule>
     <LineSymbolizer>
         <Stroke>
         <CssParameter name="stroke">#0000ff</CssParameter>
         <CssParameter name="stroke-width">2</CssParameter>
         </Stroke>
     </LineSymbolizer>
 </Rule>
</FeatureTypeStyle>
```

SLD by Example: Filters and Polygon Symbolizer (Fill)

```xml
<Rule>
    <ogc:Filter>
     <ogc:PropertyIsEqualTo>
        <ogc:PropertyName>CTRY_NAME
                </ogc:PropertyName>
        <ogc:Literal>Switzerland</ogc:Literal>
     </ogc:PropertyIsEqualTo>
    <ogc:Filter>
    <PolygonSymbolizer>
        <Fill>
            <CssParameter name="fill">#ff0000</CssParameter>
        </Fill>
    </PolygonSymbolizer>
</Rule>
```

SLD by Example: Text Symbolizer (Label)


```xml
<TextSymbolizer>
  <Geometry>
    <ogc:PropertyName>LABELPOS</ogc:PropertyName>
  </Geometry>
  <Label>
    <ogc:PropertyName>Name</ogc:PropertyName>
  </Label>
  <Font>
    <SvgParameter name="font-family">Arial</SvgParameter>
    <SvgParameter name="font-family">Sans-Serif</SvgParameter>
    <SvgParameter name="font-style">italic</SvgParameter>
    <SvgParameter name="font-size">26</SvgParameter>
  </Font>
  <Halo>
    <Radius>1</Radius>
    <Fill>
      <SvgParameter name="fill">#ffffff</SvgParameter>
    </Fill>
  </Halo>
  <Fill>
    <SvgParameter name="fill">#000000</SvgParameter>
  </Fill>
</TextSymbolizer>
```

What have we learned?

- Common Exchange = Interoperability = Standards
- Relevant open standards for Web Cartography
- WMS Requests
  - GetCapabilities
  - GetMap
  - GetFeatureInfo
- SLD
  - General Structure
  - Rules
  - Filters
  - Symbolizers* (Point, Line, Polygon, Text)
    * (the Raster Symbolizer was not presented)

Questions

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Exercise 6

- ## WMS and SLD:

  - Understand the WMS protocol

  - Customize the generated SLD from admin.sld

  - Integrate the WMS layers into your Leaflet map