

Maps for Spatial Data Infrastructures (Service-Oriented Web Mapping)

Ionuț Iosifescu

Spatial Data Infrastructures ?!?



Image courtesy of INSPIRE



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Spatial data infrastructure SDI

The goal of a Spatial data infrastructure (SDI) is to provide users direct access to geoinformation and geoservices from a variety of suppliers.

A SDI is a public access system of (political) measures, institutional facilities, technologies, data and people to provide a common exchange and efficient use of geographical information.

SDIs exist on different levels. Communes, cities and cantons could install SDIs, the **Federal Spatial Data Infrastructure** for instance concerns the geodata of the Confederation, the **National Spatial Data Infrastructure** includes public organisations as well as private enterprises. On the European level we find Eurogeographics and INSPIRE.

Please find more information on this topic on the geoportal of the Swiss Confederation:

- [Federal Spatial Data Infrastructure \(FSDI\)](#) ↗
- [INSPIRE](#) ↗

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Spatial Data Infrastructures

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Components of Spatial Data Infrastructures

- Access
- Geoinformation
- Geoservices
- Political framework
- Institutional facilities
- Technologies
- Data
- People
- Common Exchange

The screenshot displays the geo.admin.ch website. At the top, there is a navigation bar with tabs for 'Aktuell', 'Geodaten', 'Karten', 'Thematische Geoportale', 'Dienstleistungen', and 'Über geo.admin.ch', along with a 'Share' button. Below the navigation bar, the page title reads 'geo.admin.ch: das Geoportal des Bundes'. A search bar is positioned on the right with the placeholder text 'nach Geodaten suchen...'. The main content area features several tiles: a large red tile for the '2014 Public SWISS ICT AWARD' with a Swiss flag graphic; a circular black tile with a white map of Switzerland; a blue 'VERBINDEN' tile; a grey 'GESETZ' tile; a grey 'KARTEN' tile; a blue 'FAQ' tile; a red 'TOP VIEWS' tile with a map snippet; a blue 'NEWS' tile; and a video player tile showing a building. At the bottom, there is a horizontal menu with labels: 'GEODATEN', 'KARTEN', 'THEMATISCHE', 'DIENSTLEISTUNGEN', and 'ÜBER GEO.ADMIN.CH'.

Image courtesy of swisstopo

Spatial Data Infrastructure Levels

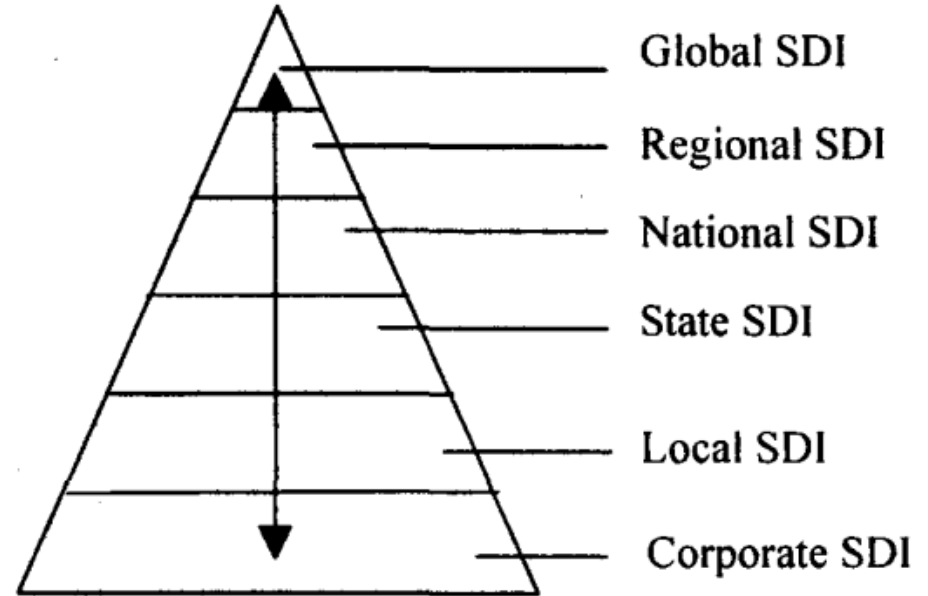
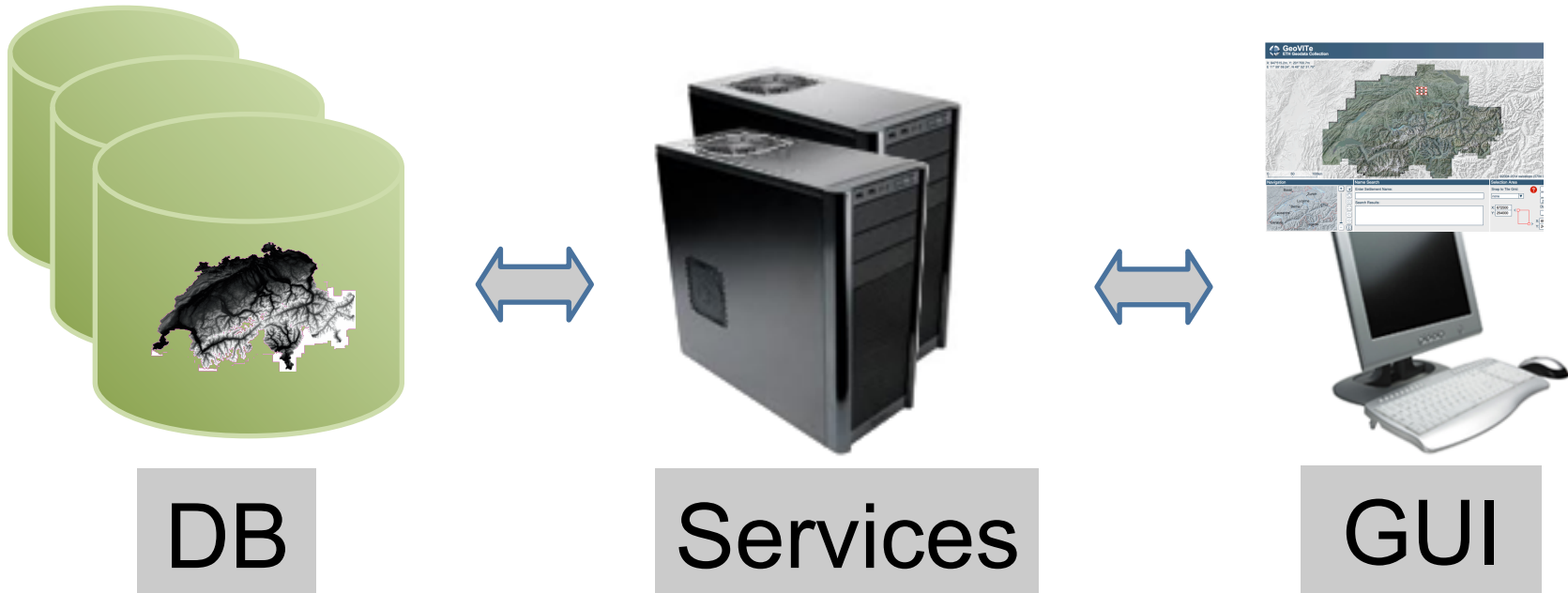


Image courtesy of Rajabifard et al., 2000.
<http://dSPACE.uah.es/dSPACE/bitstream/handle/10017/6818/%28HSR%29Spatial%20data.pdf?sequence=1>

What Does an SDI Means in practice?

- **Access + Geoinformation + Geoservices + Common Exchange**
- **Geoportal** for User Access (User-friendly Presentation)
- **(Web) Services** for Access to Geodata (Application Logic, enables functionalities presented in the Geoportal)
- **Geodatabases** for proper management of Geoinformation (Data Management)
- **Common Exchange = Standards**

Generic Three-tier Architecture



User Access through Geoportals

GeoVITE
ETH Geodata Collection

Welcome, Ionuț Iosifescu Enescu
INSTITUTE OF CARTOGRAPHY AND GEOINFORMATION
Logout

X: 947515.2m, Y: 201700.7m
E 11° 59' 59.24", N 46° 52' 31.75"

0 50 100km

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Navigation

Name Search
Enter Settlement Name:
Search Results:

Selection Area
Snap to Tile Grid: none
X: 672500
Y: 254000
X: 690000
Y: 242000

Geodata Browser Download Cart Info Help

Geodataset
Map Category: Airborne Orthoimages
Map Product: Topographic Vector Maps
Description of Swiss Topographic Raster Maps
The orthophoto is a composition of digital images of the ground resolution: 0.5m
Digital Elevation Models
Historic Maps
Thematic Maps

>> More info

Layers for Download
 Swissimage 50 (1999-2009)
 Swissimage 50 L1 (2005)

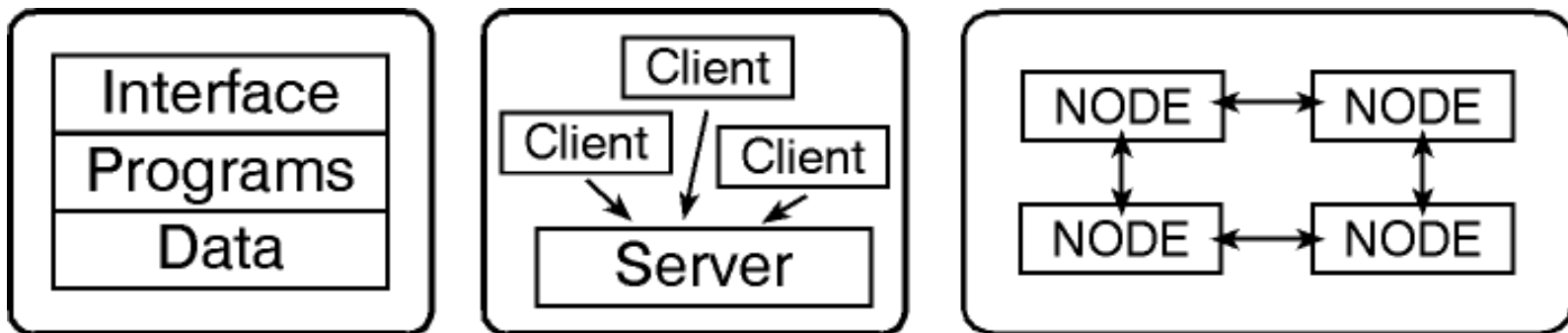
Select all / none

Download Tools
Add Selection to Download Cart
Max. Area (sqm): 20'000'000
Current Area (sqm): 210'000'000

Background Display (not included in download)
 Relief

Geoservices are linked to Distributed Systems

- A **distributed system** consists of a collection of autonomous **computers**, connected through a **network**, that communicate according to some **protocol (messages)** via **documented interfaces** in order to present to the user an integrated system.



Geoservices / SOA

- Visualization Services
- Geoprocessing Services
- Geocoding Services
- Metadata/Catalog Services
- Location Based Services
- ...
- Service Chaining
- Support Services
(persistence, schema mapping, translation)

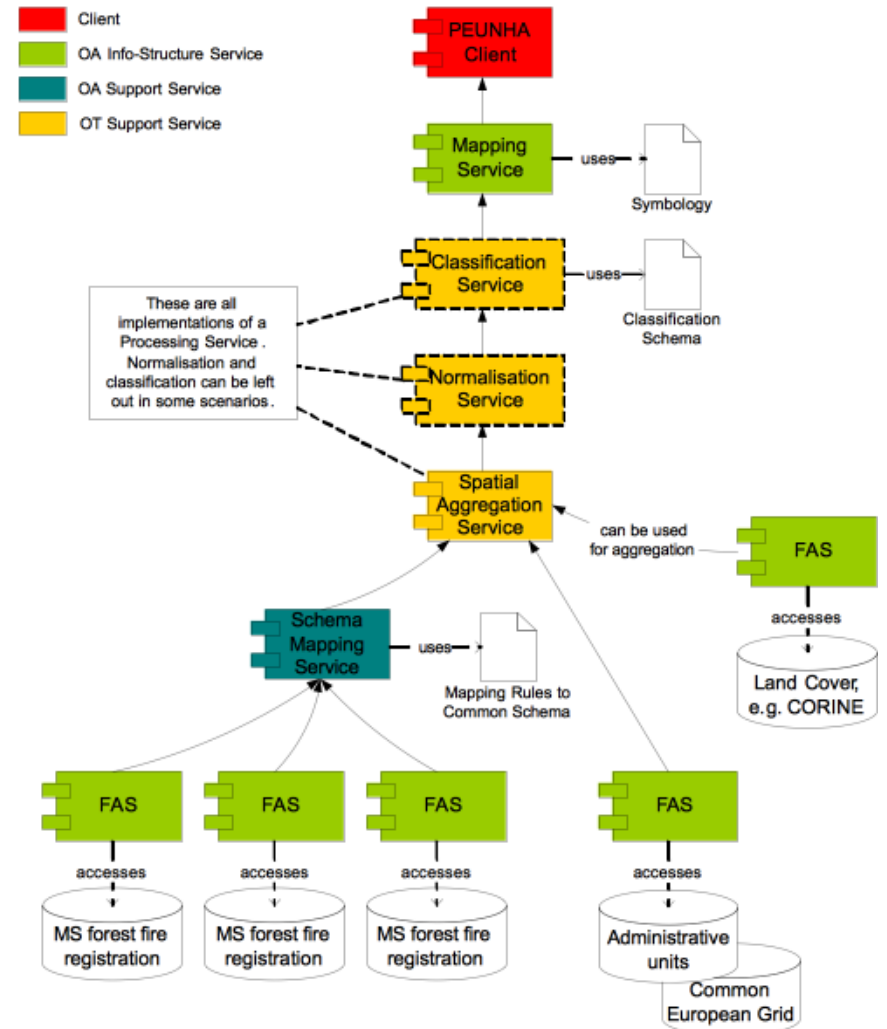


Image courtesy of EU FP6 ORCHESTRA

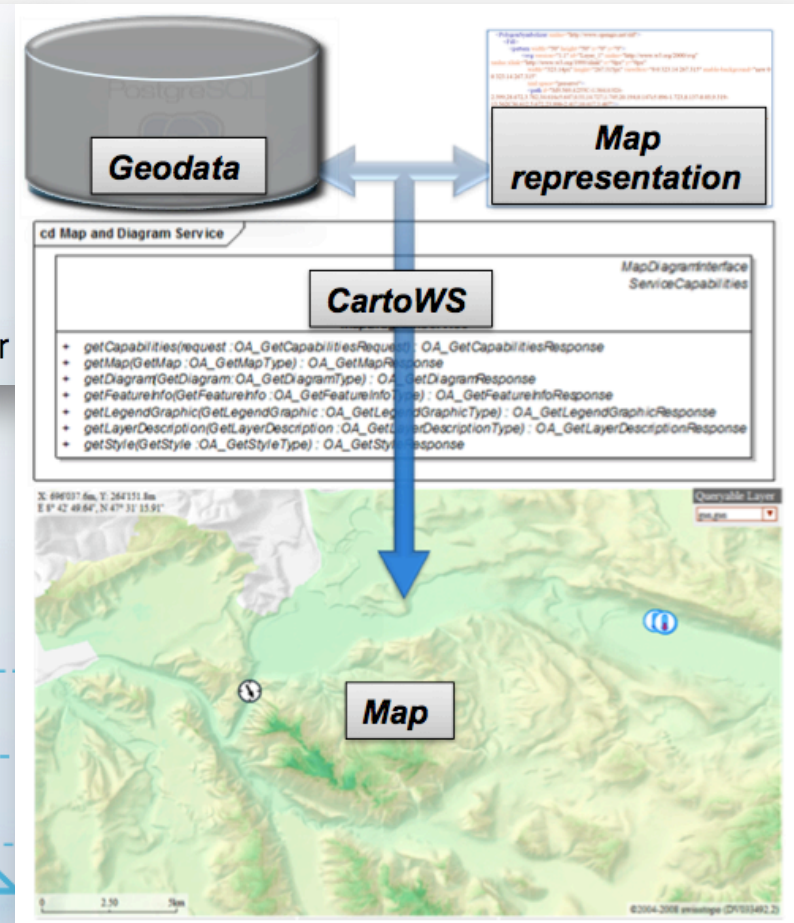
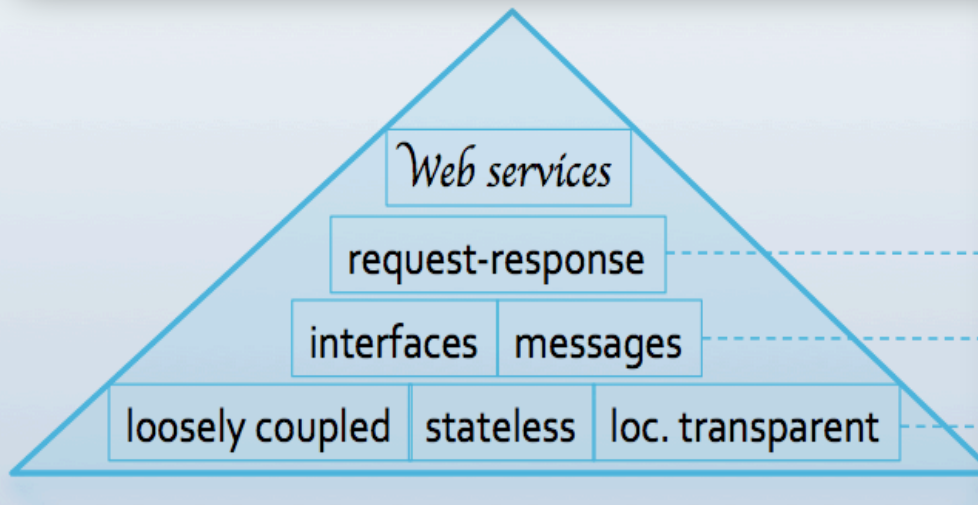
Geodatabases (1)

- Databases that can store and manage geoinformation as a collection of relational tables (relational databases) or objects (object-oriented databases)
- Features:
 - Spatial geometry types and spatial reference systems (it can import / export / manage geodata)
 - Spatial indexes (performance)
 - Spatial functions (geometrical processing, measurement and analysis functions)
- Example: PostGIS (spatial extension) and PostgreSQL (core database engine)

Geodatabases (2)

- Data consistency and integrity (“ACID” properties)
- Multiuser support, concurrency
- Performance (spatial index, DB optimizations)
- SQL query language (with geometry data types and spatial functions)
- Reduced data redundancy
- Prevents updating errors
- Independence of specific GIS formats
- Improved data security and fault-tolerance
- Easy to use for programming Geoservices

Service-Oriented Cartography in a Nutshell



Copyright: Iosifescu, 2011

Web Servers and Web Map Servers

- **Web Server**
 - Software on the **server** that handles the communication with the Web browser (usually over port 80 – **HTTP protocol**)
 - Serves content to the Web browser
 - Communication mechanism: request-response
- **Web Content**
 - Static: XHTML pages, documents, files available on the server
 - **Dynamic**: generated each time with a new request (e.g. CGI applications, Java servlets, JSP, ASP, etc...)
- **Web Map Server**
 - Dynamic rendering of georeferenced information
 - Renders **maps as images** for display in the Web browser

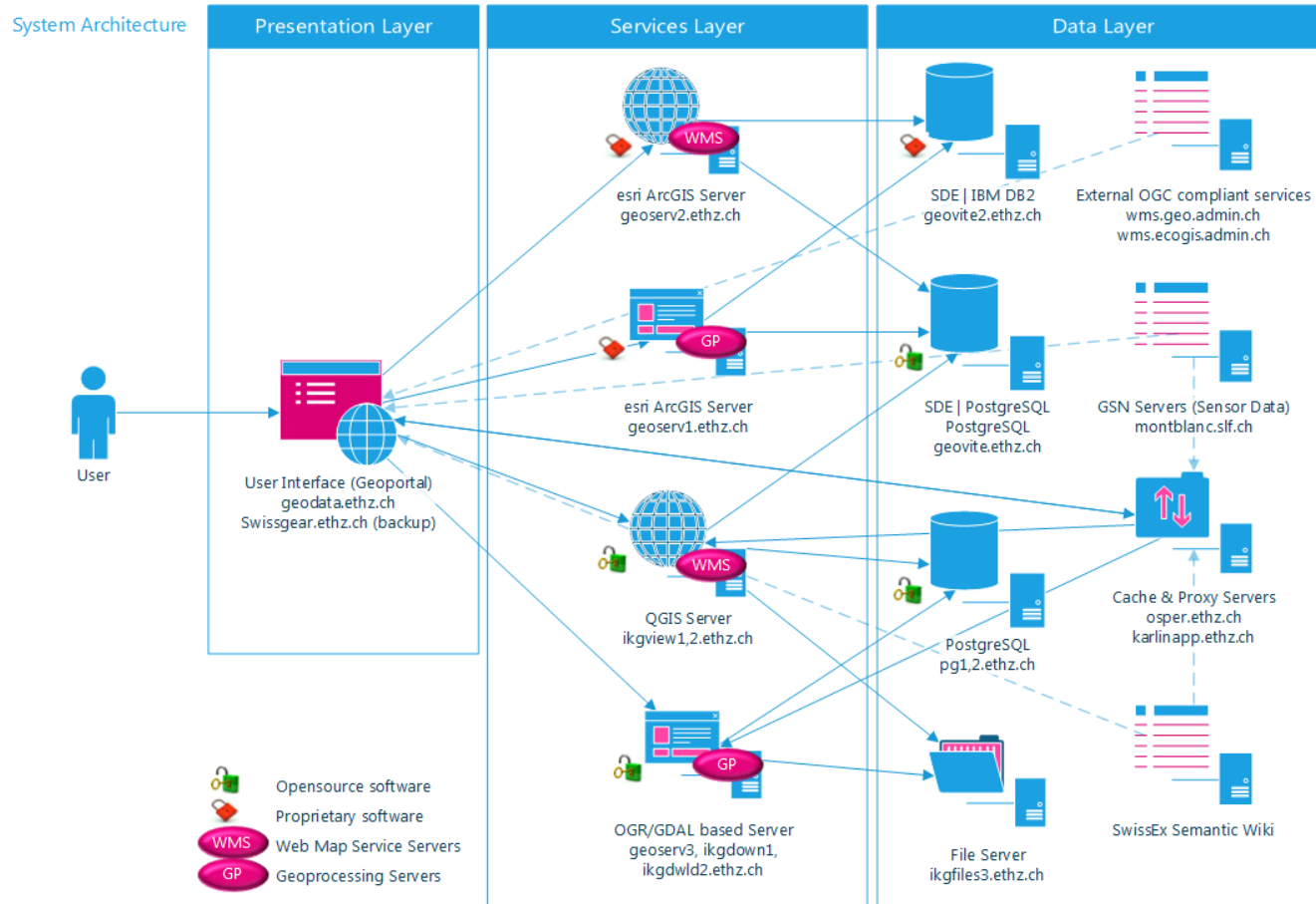
Server-side vs. Client-side Web Mapping

- The displayed map content is created by a remote server (e.g. a Web Map Server) instead of the client browser
- Each map interaction/navigation in the geoportal triggers a **request** to the map server
- The **server is preparing the map content** (e.g. rendering) the requested data/map in a Web-friendly format (e.g. an image)
- The image is sent back to the client as **response**
- The Web browser / geoportal **displays** the image
- Server-side and client-side rendering can be combined
- **Let's discuss the advantages and disadvantages!**

Client-side vs. Server-side Web Mapping

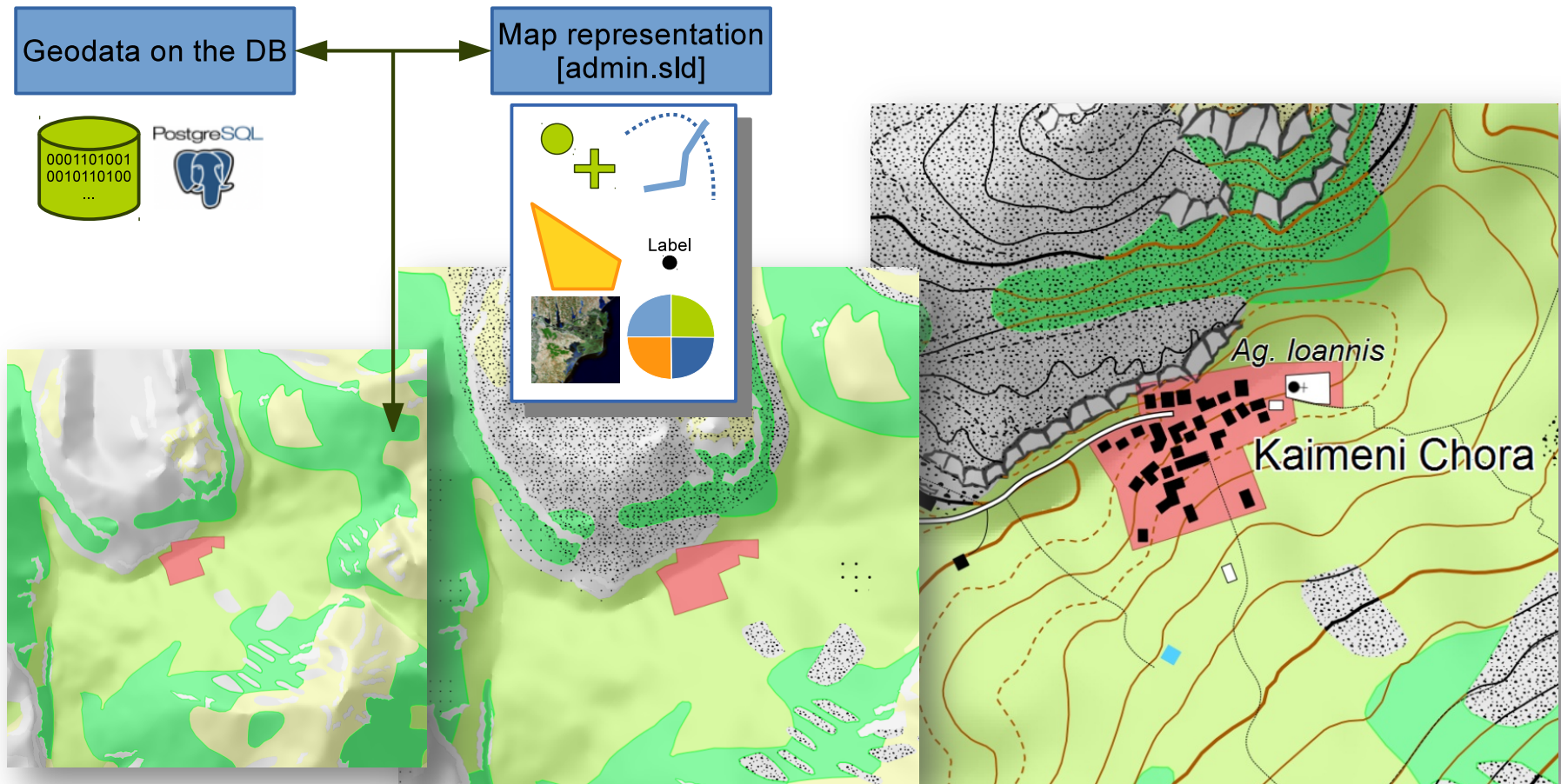
- **client-side interactivity:**
 - A “thick” client is downloaded from the server
 - Map content and application are downloaded together
 - All interactivity is executed on the client
 - All interactivity is independent of the Internet connection
 - Performance is browser dependent
 - Data amount limited
- **server-side interactivity:**
 - Only a “thin” client is downloaded from the server
 - Each interaction requires communication with the server
 - All interactivity is dependent of the Internet connection
 - Performance is browser independent
 - Can handle huge amounts of data and distributed data sources
- **Client-side and Server-side interactivity can be freely combined in a Web Map**

ETH SDI in Practice



Copyright: Iosifescu et al., 2014

Cartographic Visualization in an SDI



What have we learned?

- What is the goal of an SDI
- Components of an SDI
- Levels of an SDI
- Generic three-tier Architecture of an SDI (data, application and presentation layers)
- An overview on Geoportals, Geoservices, Geodatabases
- Service-oriented Cartography
- Server-side vs. client-side Web mapping

Questions



Exercise 5

- **Creating Map Services:**
 - Start your local map server
 - Start QGISPublishtoWeb
 - Load Shapefiles and symbolize them
 - Export to the web using the 'Publish to web' plugin
 - Test the created map services