Η Διαλειτουργικότητα στη Γεωγραφική Πληροφορία

OGC® Open Geospatial Consortium, Inc.

www.opengeospatial.org

Παρασκευή
03/04/2009

Ledra Marriott Hotel

Hellas G.I.S

www.hellasgi.gr

Development of an Open Source-based Regional SDI for Heraklion Prefecture

Emmanuel Stefanakis & Poulicos Prastacos

Harokopio University of Athens
Department of Geography
estef@hua.gr

FORTH & InfoCharta Ltd
STEP-C, Heraklion
poulicos@iacm.forth.gr

Stefanakis, E.; Prastacos, P. Development of an open source-based spatial data infrastructure. Applied GIS. 2008 Oct;4(4): 1-26.
http://arrow.monash.edu.au/vital/access/manager/Repository/monash:7759

The Heraklion SDI

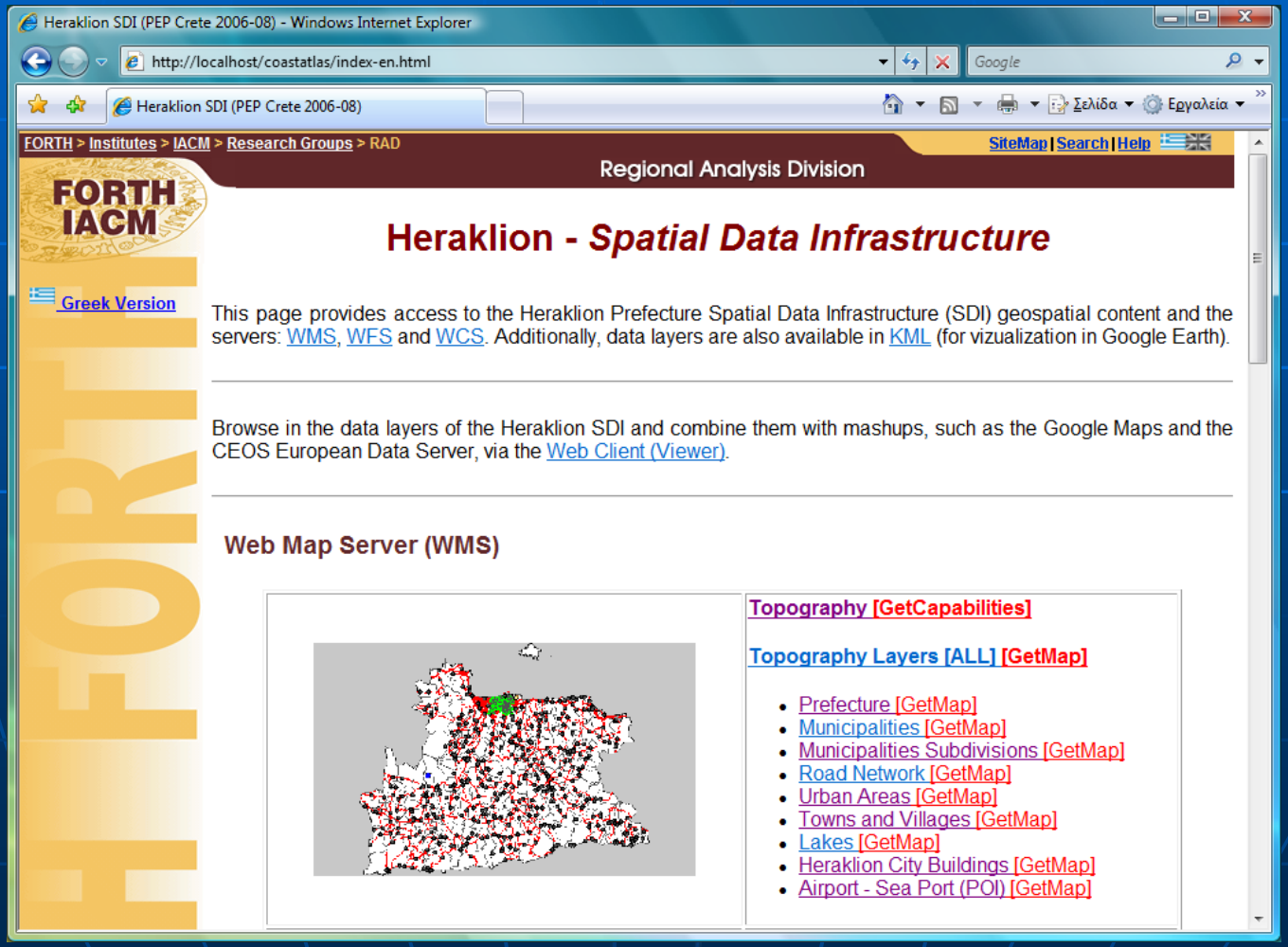
- A regional SDI …
  - has recently been developed for the Heraklion Prefecture in Crete, Greece
  - using merely …
    - Geographic Free and Open Source Software (**GeoFOSS**)
    - funded by the GSRT (ΓΓΕΤ – ΠΕΠ Κρήτης)

http://heraklion-sdi.dynalias.net/coastatlas/index-en.html

Heraklion SDI

- The Web page...

http://heraklion-sdi.dynalias.net/coastatlas/index-en.html



Heraklion SDI

- This SDI is ...
  - **compatible** with the geospatial **standards and specifications** introduced by the Open Geospatial Consortium (**OGC**), and
  - serves the geospatial content through widely accepted **web services** (e.g., WMS, WFS, WCS and CSW)

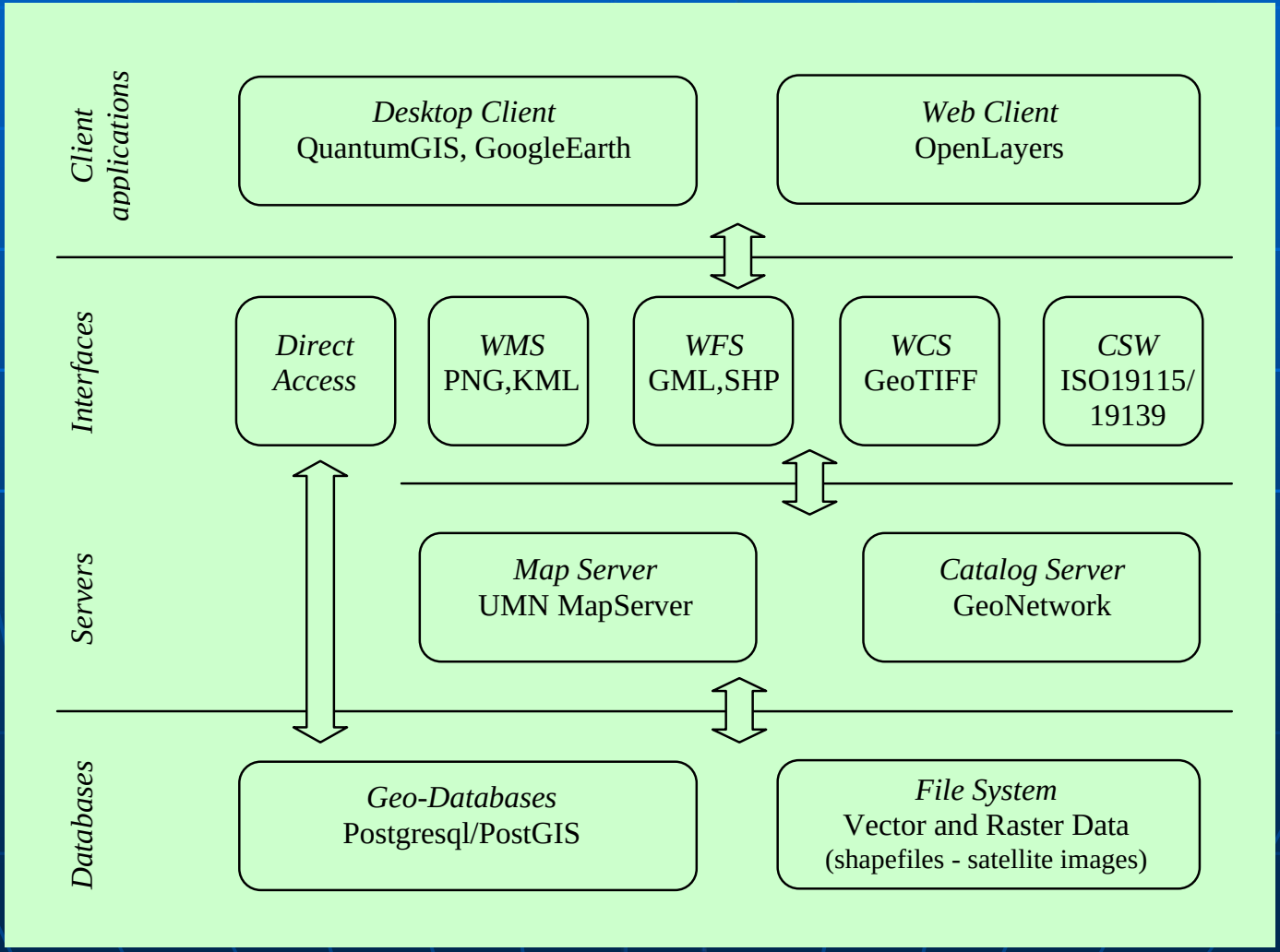
Heraklion SDI

- Public Datasets …

Layer Content/Description	*Format*	*Name*
Prefecture (outline)	Shapefile	*nomos_irakliou*
Municipalities (outlines)	Shapefile	*dhmoi_irakliou*
Municipalities Subdivisions (outlines)	Shapefile	*dhm_diamer_irakliou*
Urban Areas (outlines)	Shapefile	*bua_irakliou*
Towns and Villages (points)	Shapefile	*oikismoi_irakliou*
Road Network (lines)	Shapefile	*odiko_irakliou*
Heraklion City buildings (polygons)	Shapefile	*build_egsa*
Heraklion city Airport and Seaport (points)	Shapefile	*poi_irakliou*
Lakes (polygons)	Shapefile	*limnes_irakliou*
Geology cover (polygons)	Shapefile	*geo_N_Herakleio*
Archaeological spots (points)	Shapefile	*archaiologia_N_Herakleio*
Digital Elevation Model (raster)	GeoTiff	*dem*
Land Cover (raster)	GeoTiff	*lc*
Orthophoto Map (raster)	GeoTiff	*hr_ortho*

Architecture & Software Systems

- The architecture...

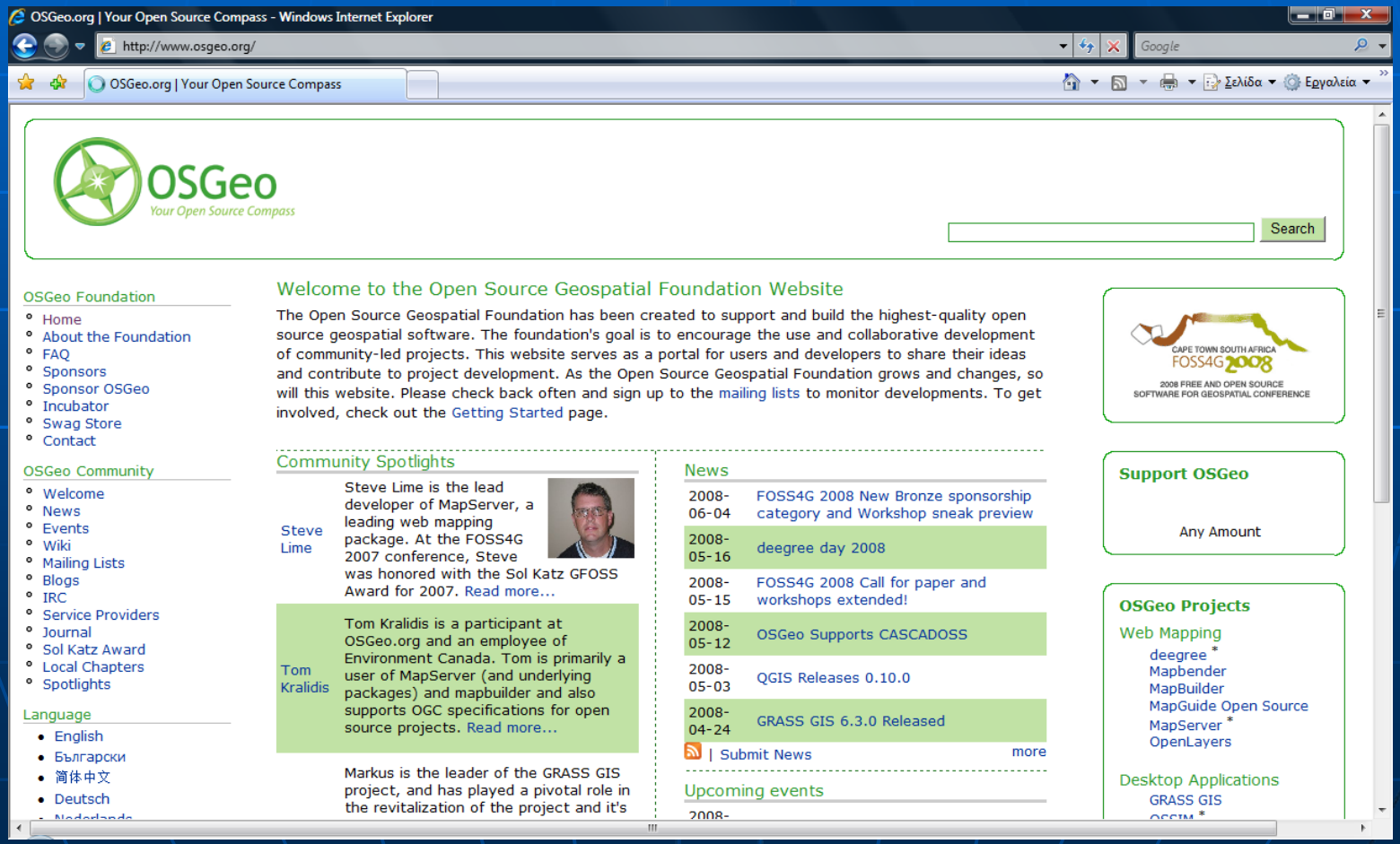


Architecture & Software Systems

- The geospatial layers of the SDI are served using ...
  - Services: WMS, WFS, WCS
  - Languages: GML, KML
  - Standards: ISO19115/139
- They are visualized via ...
  - a web application (web client)
  - a desktop GIS / GE (desktop client)

Architecture & Software Systems

- Open Source Software Systems...

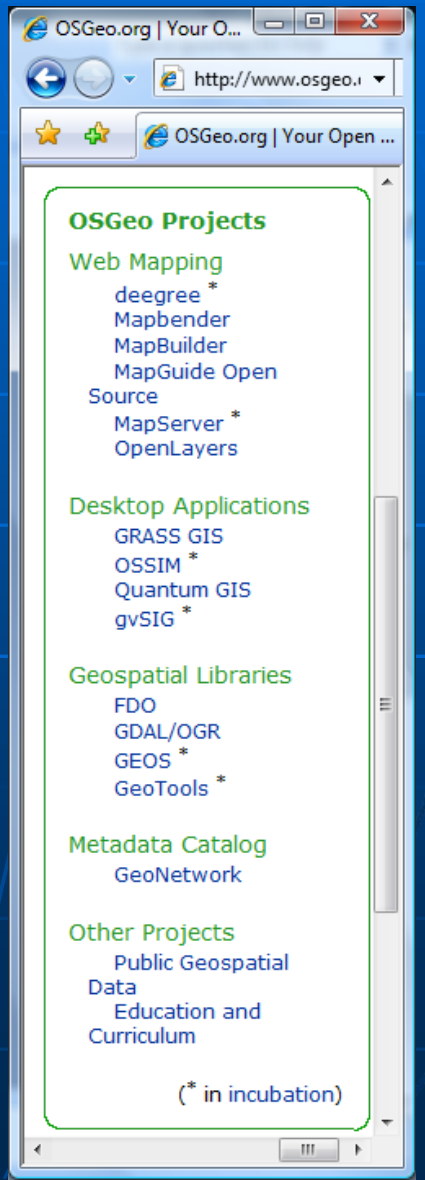


http://www.osgeo.org/

Architecture & Software Systems

- OSGeo...
  - The Open Source Geospatial Foundation...
    - has been created to support and build the highest-quality open source geospatial software
  - The foundation's goal is....
    - to encourage the use and collaborative development of community-led projects

http://www.osgeo.org/



Architecture & Software Systems

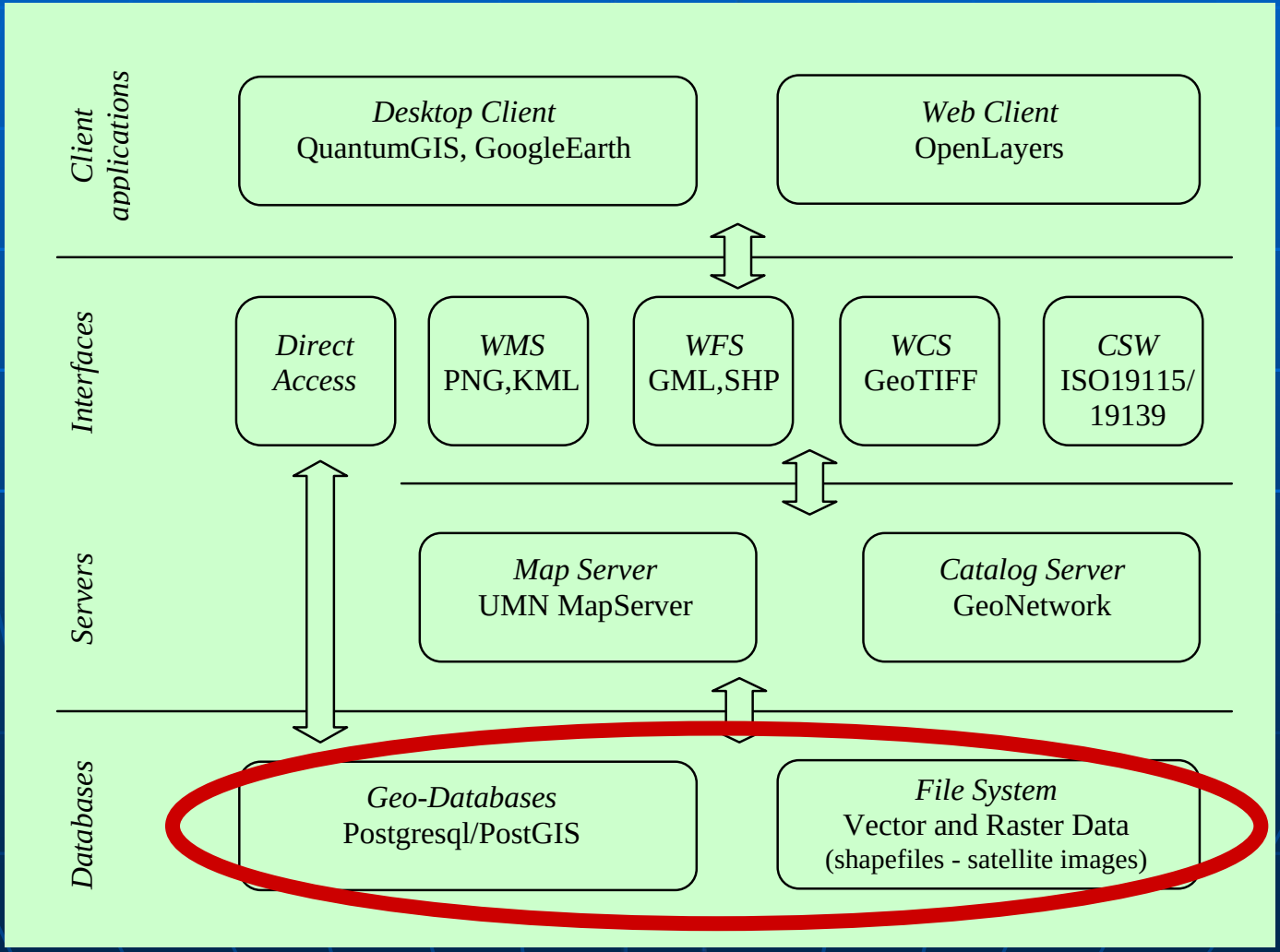
- Software Systems...
  - *Apache Web Server* (http://www.apache.org) in the role of the **Web Server**.
  - *OpenLayers JavaScript Library* (http://openlayers.org) in the role of the **Web Client** (Interface).
  - *QuantumGIS* (http://www.qgis.org) in the role of the **Desktop Client**.
  - *Google Earth* (http://earth.google.com) in the role of the **Desktop Client** (for the KML files).

Architecture & Software Systems

- Software Systems… (cont')
  - *UMN MapServer* (http://mapserver.gis.umn.edu) in the role of the **Map Server**.
  - *GeoNetwork Opensource* (http://geonetwork-opensource.org) in the role of the **Catalog Server**.
  - *GDAL/OGR* (http://www.gdal.org) in the role of the **Geospatial Library**.
  - *Postgresql/PostGIS* (http://www.postgis.org) in the role of the Spatial **Database Server**.

Architecture & Software Systems

- The architecture...

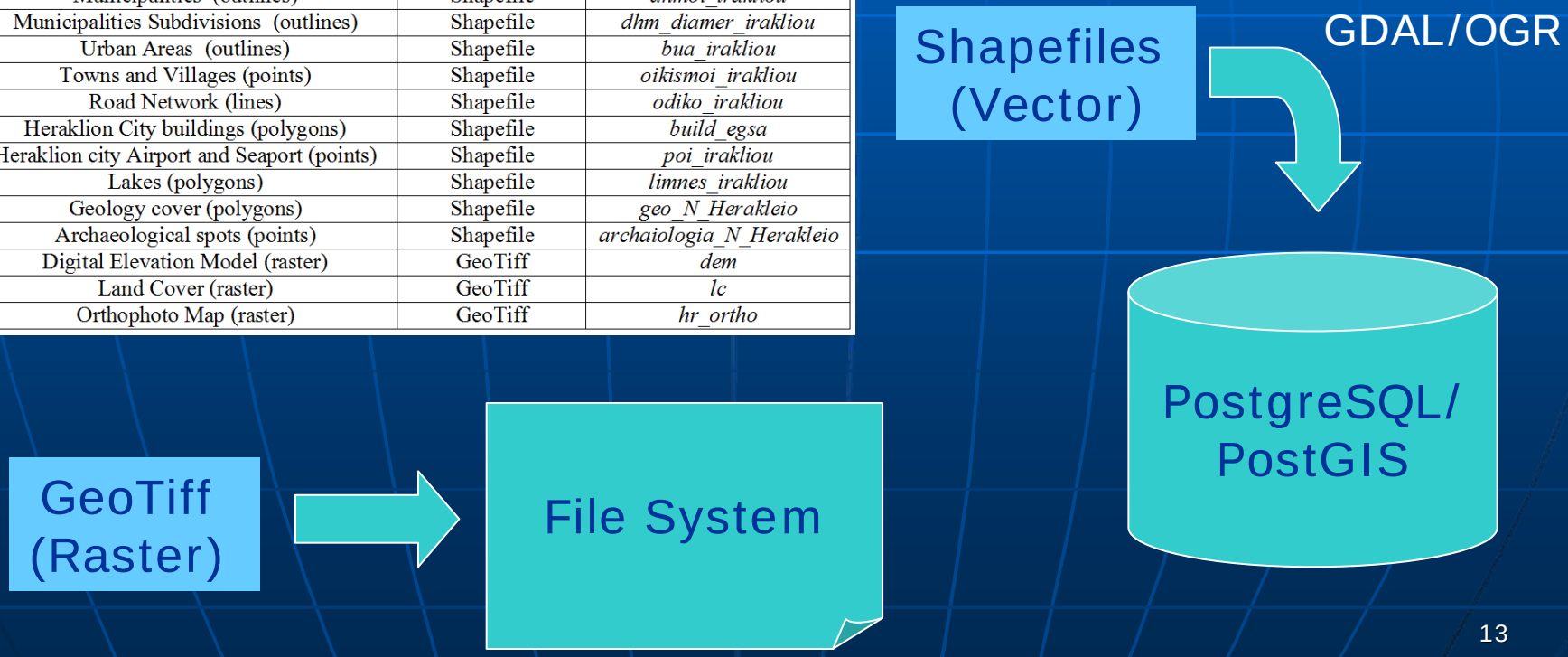


Heraklion SDI

- The Geo-Databases...

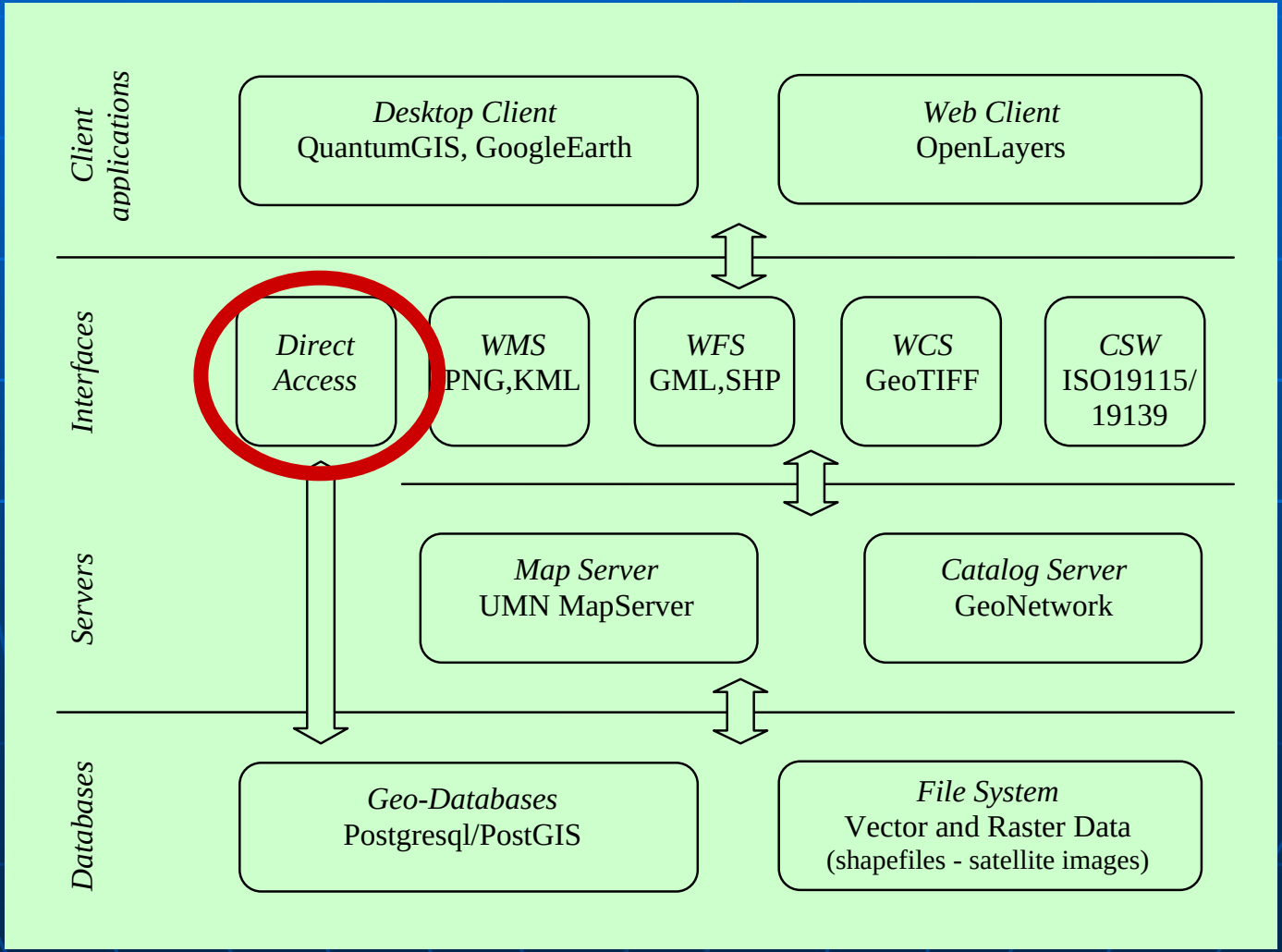
SDI Public Layers

Layer Content/Description	*Format*	*Name*
Prefecture (outline)	Shapefile	*nomos_irakliou*
Municipalities (outlines)	Shapefile	*dhmoi_irakliou*
Municipalities Subdivisions (outlines)	Shapefile	*dhm_diamer_irakliou*
Urban Areas (outlines)	Shapefile	*bua_irakliou*
Towns and Villages (points)	Shapefile	*oikismoi_irakliou*
Road Network (lines)	Shapefile	*odiko_irakliou*
Heraklion City buildings (polygons)	Shapefile	*build_egsa*
Heraklion city Airport and Seaport (points)	Shapefile	*poi_irakliou*
Lakes (polygons)	Shapefile	*limnes_irakliou*
Geology cover (polygons)	Shapefile	*geo_N_Herakleio*
Archaeological spots (points)	Shapefile	*archaiologia_N_Herakleio*
Digital Elevation Model (raster)	GeoTiff	*dem*
Land Cover (raster)	GeoTiff	*lc*
Orthophoto Map (raster)	GeoTiff	*hr_ortho*



Architecture & Software Systems

- The architecture...



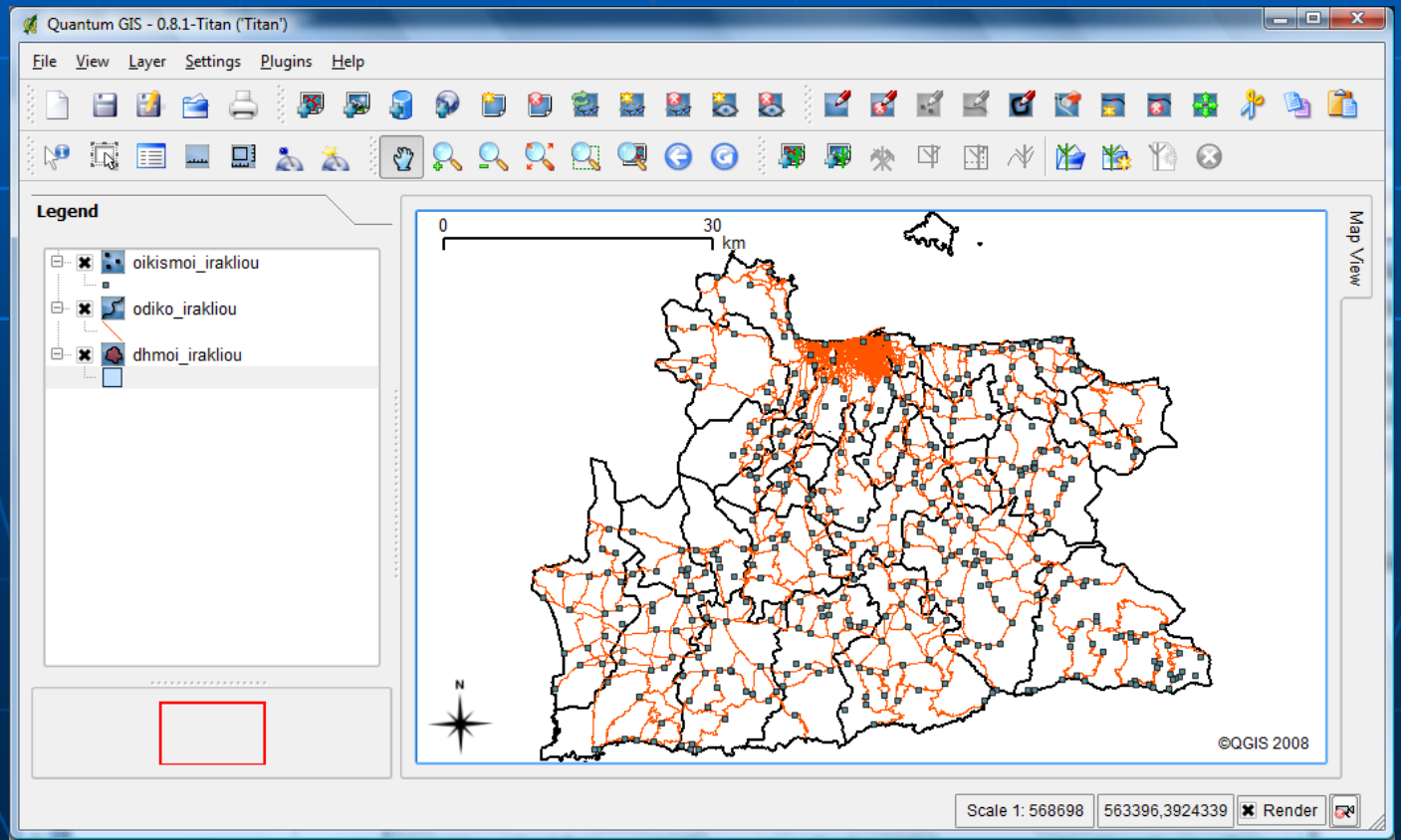
Heraklion SDI

- The middle layer...
  - provides the **Direct Access Interface**
    - to the geospatial content that resides in the spatial database server
  - The Direct Access Interface ...
    - may support effectively...
      - the querying and
      - the analysis

      ... of the geospatial content using SQL statements

Heraklion SDI

- The **Direct Access Interface**…
  - Example queries…



- **Table of Municipalities: “dhmoi_irakliou” (type: multi_polygon)**

```
SELECT gid, NAMF_EN, POP_01, AsText(the_geom)
FROM dhmoi_irakliou;
```

gid (identifier)	NAMF_EN (municipality name)	POP_01 (population in 2001)	the_geom (geometry column)
1	Municipality Of Irakleio	137711	MULTIPOLYGON(…)
2	Municipality Of Agia Varvara	5310	MULTIPOLYGON(…)
3	Municipality Of Arkalochori	10897	MULTIPOLYGON(…)
4	Municipality Of Archanes	4548	MULTIPOLYGON(…)
…	…	…	…

26 rows

- **Table of Cities/Villages: “oikismoi_irakliou” (type: point)**

```
SELECT gid, NAMEENG, POP01, AsText(the_geom)
FROM oikismoi_irakliou;
```

gid (identifier)	NAMEENG (city/village name)	POP01 (population in 2001)	the_geom (geometry column)
1	Agia Pelagia	553	POINT(592221 3918593)
2	Paralia Fodele	99	POINT(586237 3917962)
3	Achlada	119	POINT(589949 3917093)
4	Fodele	540	POINT(586850 3915575)
…	…	…	…

400 rows

- **Table of Road Network: “odiko_irakliou” (type: multi_linestring)**

```
SELECT gid, SPEED, EU_CODE, AsText(the_geom)
FROM odiko_irakliou;
```

gid (identifier)	SPEED (speed limit)	EU_CODE (E75 for national roads)	the_geom (geometry column)
1	50		MULTILINESTRING(…)
2	50		MULTILINESTRING(…)
3	80	E75	MULTILINESTRING(…)
4	70	E75	MULTILINESTRING(…)
…	…	…	…

12228 rows

Query 1: Find how many cities there are per municipality.

SQL Statement

```
SELECT r.NAMF_EN as Municipality,
   count(m.the_geom) as Number
FROM dhmoi_irakliou AS r,
     oikismoi_irakliou AS m
WHERE intersects(r.the_geom, m.the_geom)
GROUP BY r.NAMF_EN
ORDER BY number_of_cities DESC;
```

Output

```
Municipality                | Number
----------------------------+---------
Municipality Of Viannos     | 46
Municipality Of Arkalochori | 40
Municipality Of Asterousia  | 28
Municipality Of Gortyna     | 26
Municipality Of Kasteelli   | 24
…
```

Query 2: What is the length of roads fully contained within each municipality? Report only the 5 largest.

SQL Statement

```
SELECT m.NAMF_EN as Municipality,
 sum(length(r.the_geom))/1000 as Roads_km
FROM odiko_irakliou AS r,
     dhmoi_irakliou AS m
WHERE r.the_geom && m.the_geom
AND contains(m.the_geom,r.the_geom)
GROUP BY m.NAMF_EN
ORDER BY roads_km DESC
LIMIT 5;
```

Output

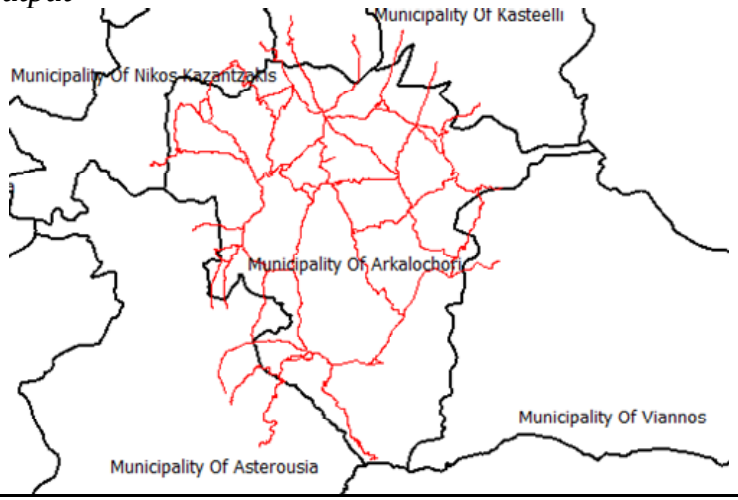
```
Municipality                | Roads_km
----------------------------+---------
Municipality Of Irakleio    | 595.440
Municipality Of Gazi        | 200.706
Municipality Of Arkalochori | 147.853
Municipality Of Asterousia  | 146.120
Municipality Of Viannos     | 137.159
----------------------------+---------
```

Query 3: Find the road segments intersected by the municipality of Arkalochori

SQL Statement

```
CREATE TABLE "ark_roads"
  (gid serial PRIMARY KEY,"id" int4);
SELECT AddGeometryColumn('','ark_roads',
  'the_geom','2100','MULTILINESTRING',2);
INSERT INTO ark_roads(id, the_geom)
SELECT r.gid, r.the_geom
FROM odiko_irakliou AS r,
     dhmoi_irakliou AS m
WHERE r.the_geom && m.the_geom
AND intersects(m.the_geom,r.the_geom)
AND m.NAMF_EN =
    'Municipality Of Arkalochori';
```

Output

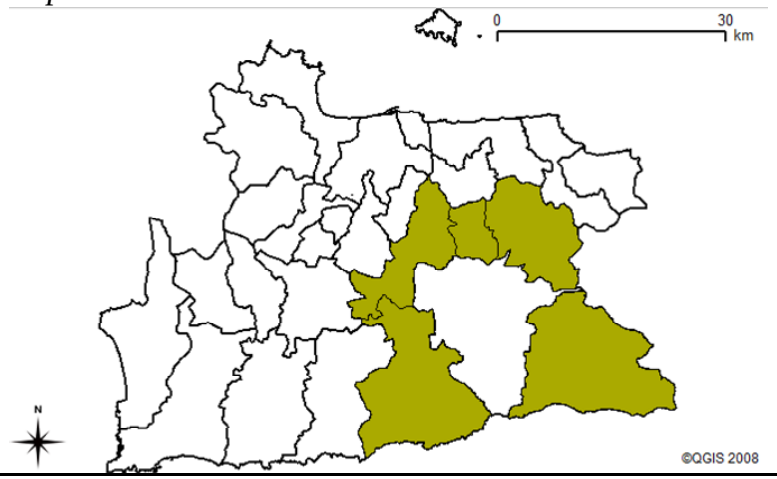


Query 4: Find the neighbors (with a common border) of the municipality of Arkalochori.

SQL Statement

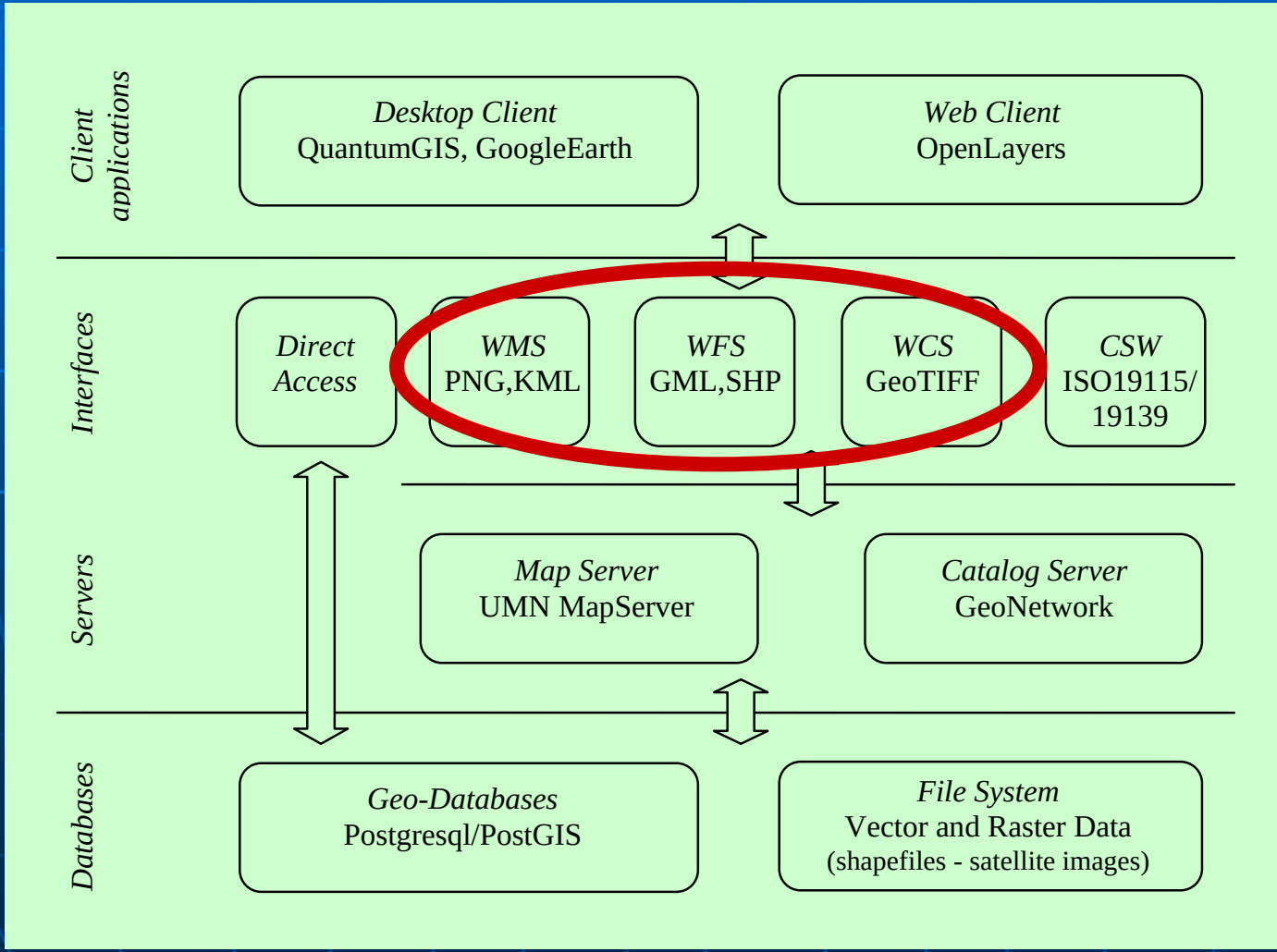
```
CREATE TABLE "ark_neigh"
  (gid serial PRIMARY KEY,"id" int4);
SELECT AddGeometryColumn('','ark_neigh',
  'the_geom','2100','MULTIPOLYGON',2);
INSERT INTO ark_neigh (id, the_geom)
SELECT n.gid, n.the_geom
FROM dhmoi_irakliou as m,
     dhmoi_irakliou as n
WHERE m.NAMF_EN =
      'Municipality Of Arkalochori'
AND Touches(m.the_geom, n.the_geom);
```

Output



Architecture & Software Systems

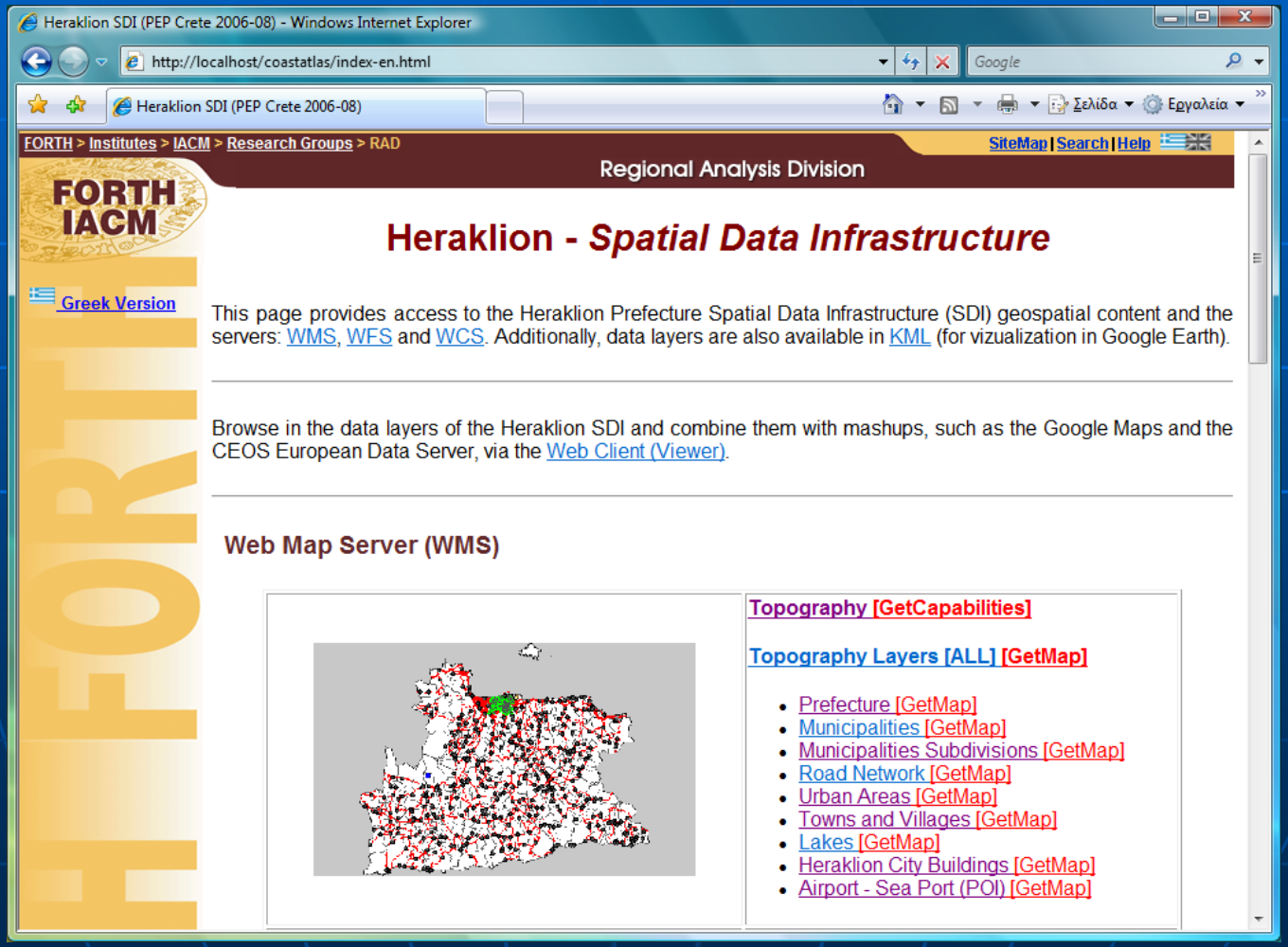
- The architecture...



Heraklion SDI

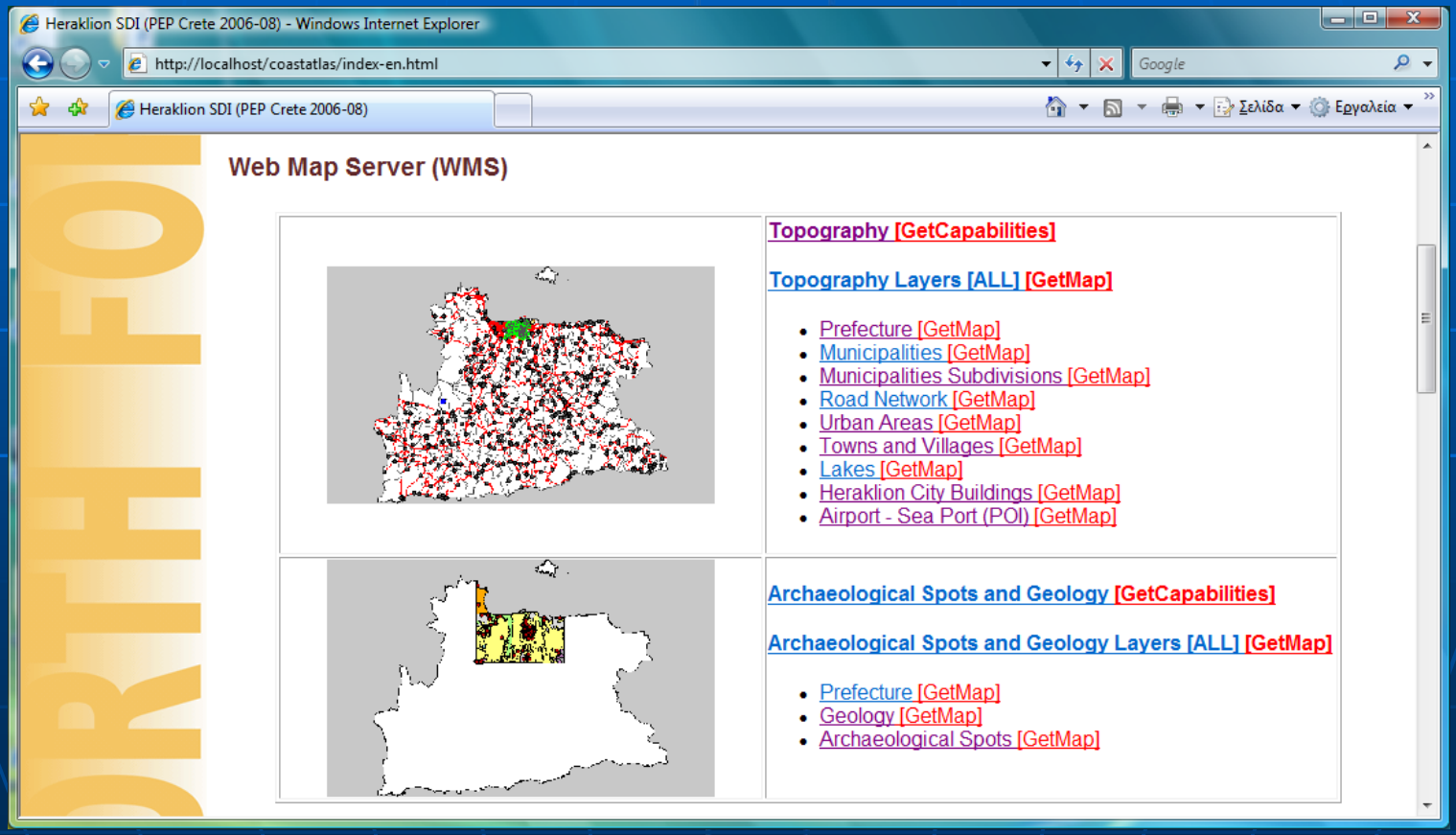
- The Web page...

http://heraklion-sdi.dynalias.net/coastatlas/index-en.html



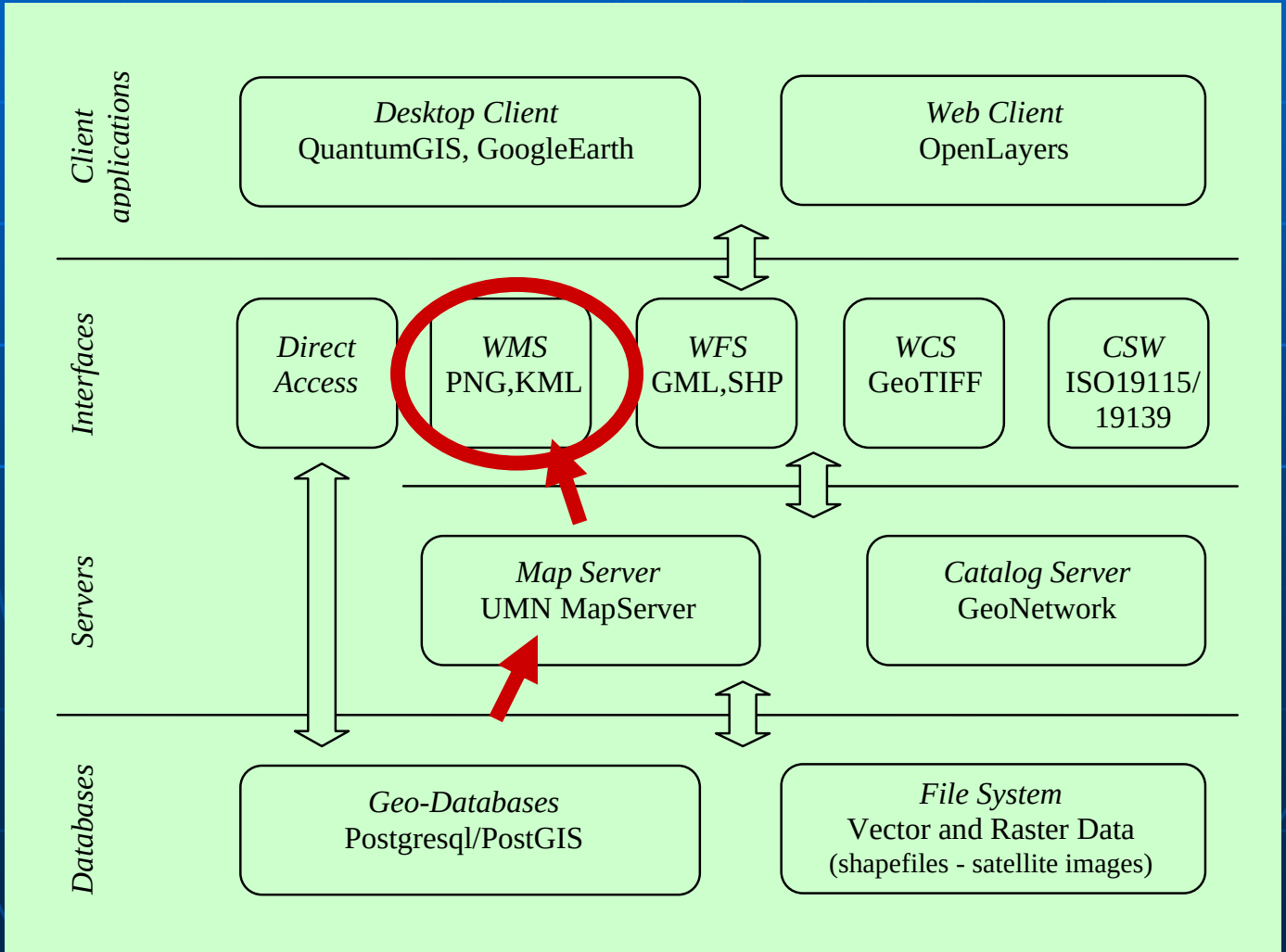
Heraklion SDI

- The Web Map Service (WMS)…



Architecture & Software Systems

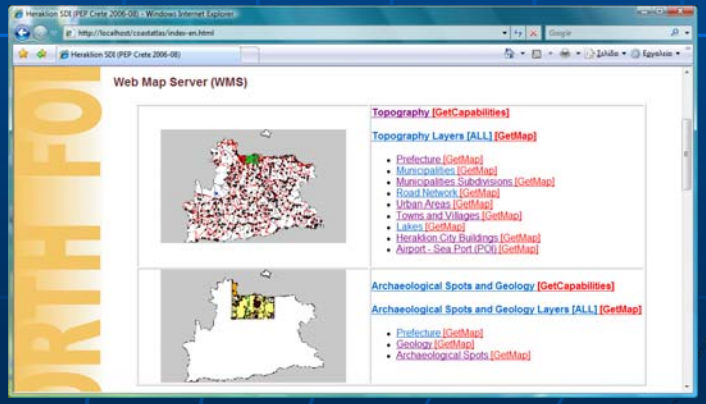
- The architecture...



Heraklion SDI

- The Web Map Service (WMS)…
  - maps served as images
    - GetCapabilities request

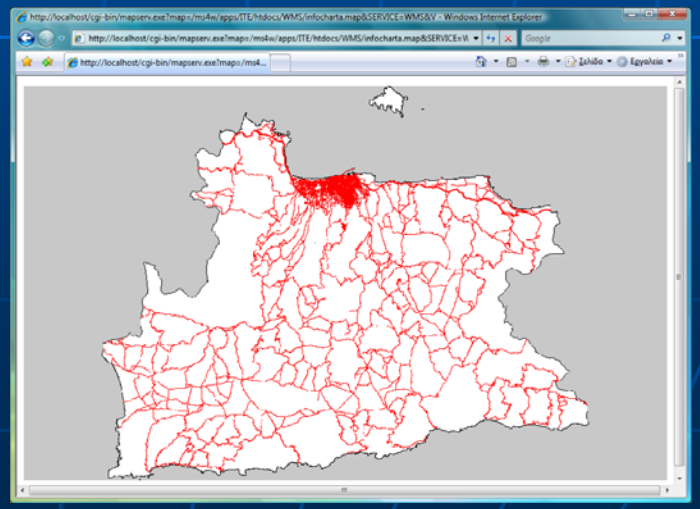
```
http://localhost/cgi-bin/mapserv.exe?
map=/ms4w/apps/ITE/htdocs/WMS/infocharta.map&
SERVICE=WMS&
REQUEST=GetCapabilities
```



Heraklion SDI

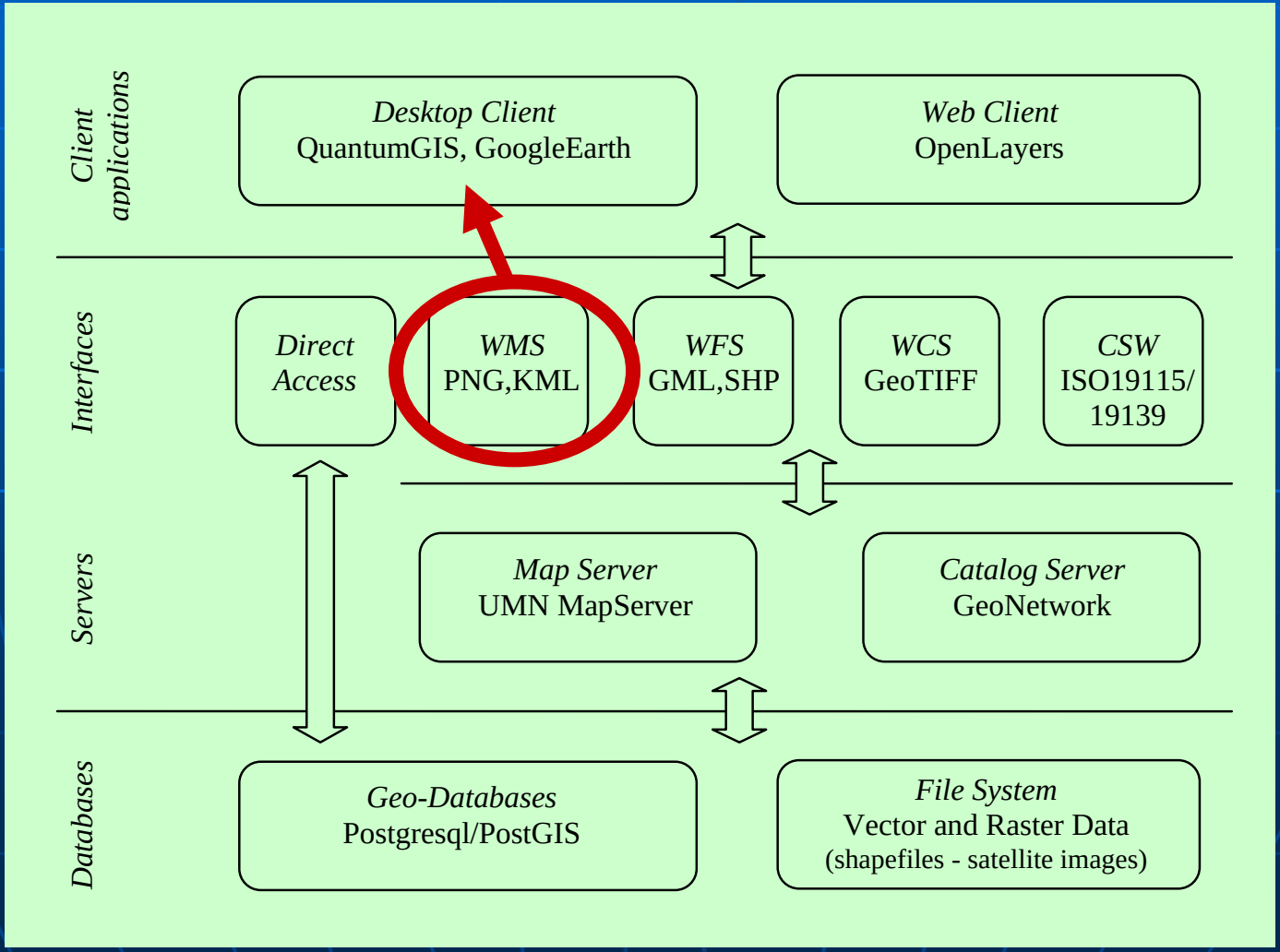
- The Web Map Service (WMS)…
  - GetMap request

```
http://localhost/cgi-bin/mapserv.exe?
map=/ms4w/apps/ITE/htdocs/WMS/infocharta.map&
SERVICE=WMS&VERSION=1.1.1&
REQUEST=GetMap&
LAYERS=odiko_irakliou&
BBOX=553530,3864020,653540,3925230&
STYLES=&
SRS=EPSG:2100&
WIDTH=500&HEIGHT=306&
FORMAT=image/png
```



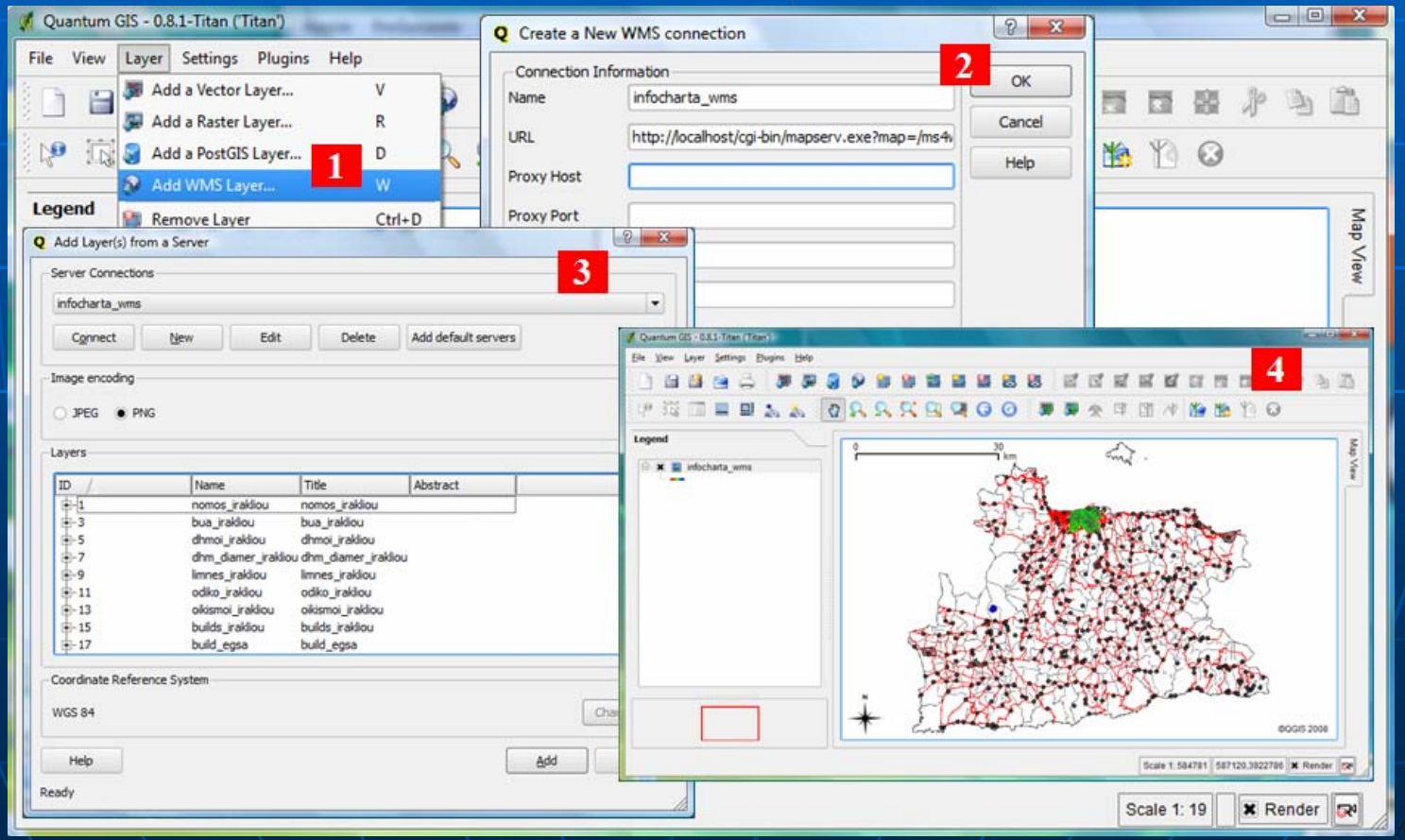
Architecture & Software Systems

- The architecture...



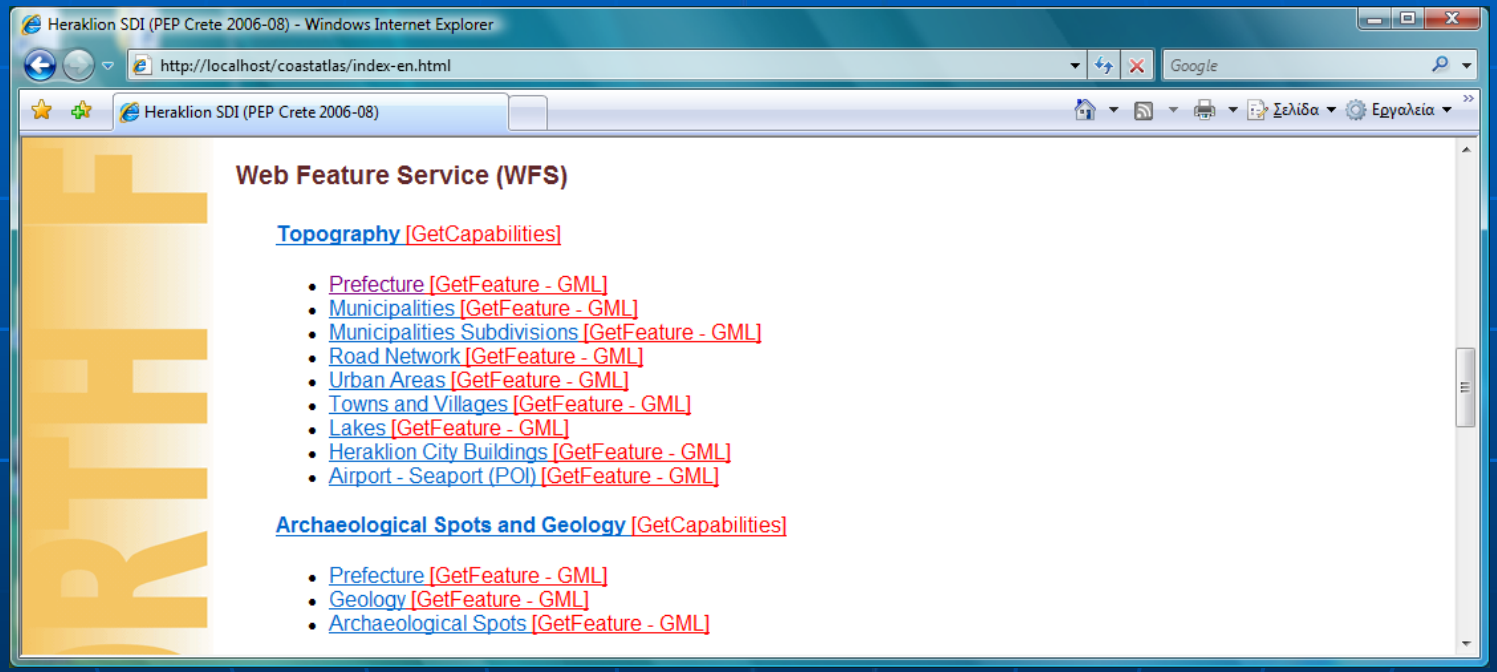
Heraklion SDI

- The Web Map Service (WMS)…
  - QGIS: Connect to the WMS



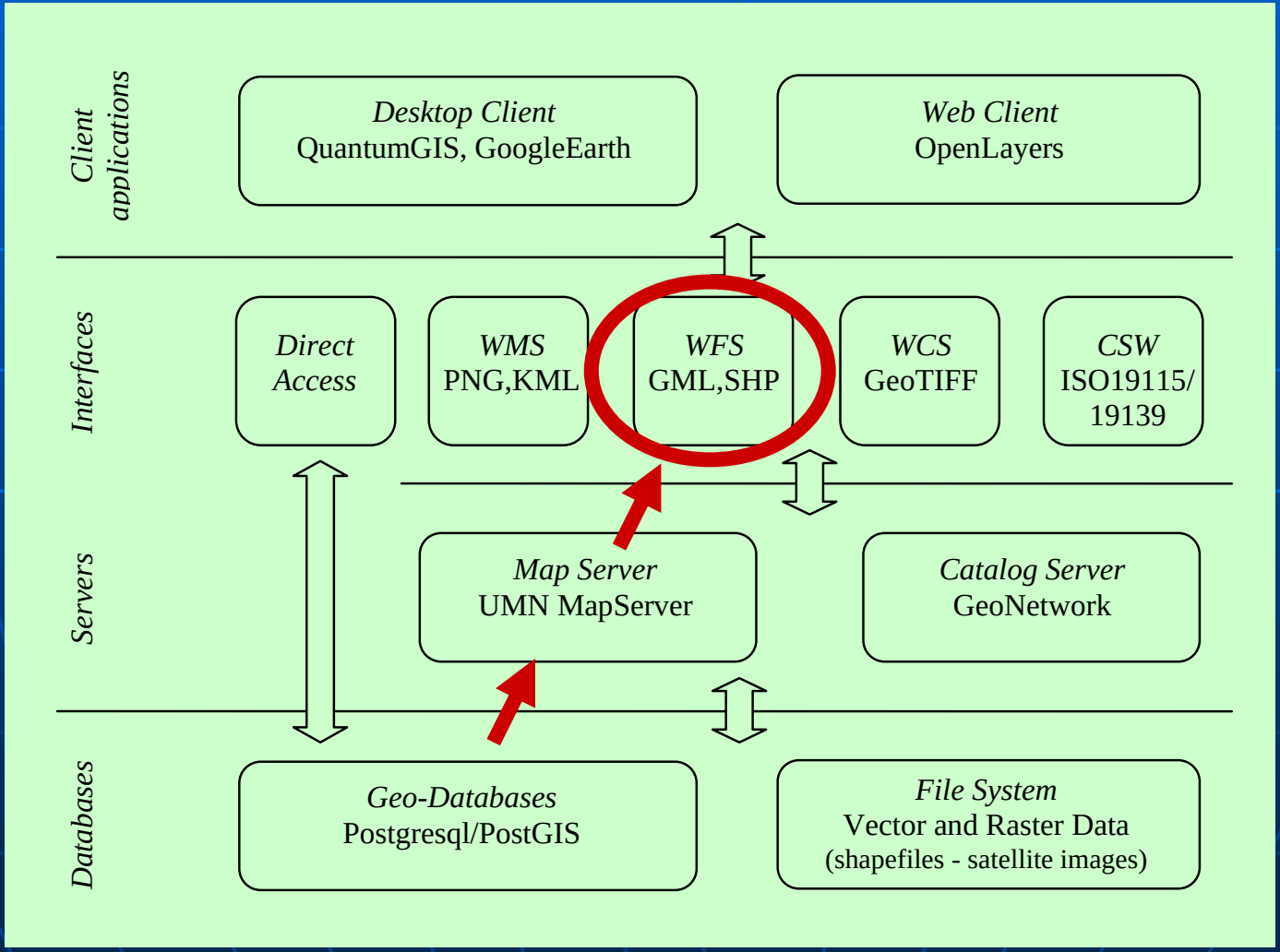
Heraklion SDI

- The Web Feature Service (WFS)…



Architecture & Software Systems

- The architecture...



Heraklion SDI

- The Web Feature Service (WFS)…
  - data served in GML
    - GetCapabilities request

```
http://localhost/cgi-bin/mapserv.exe?
map=/ms4w/apps/ITE/htdocs/WFS/infocharta.map&
SERVICE=WFS&
VERSION=1.0.0&
REQUEST=GetCapabilities
```

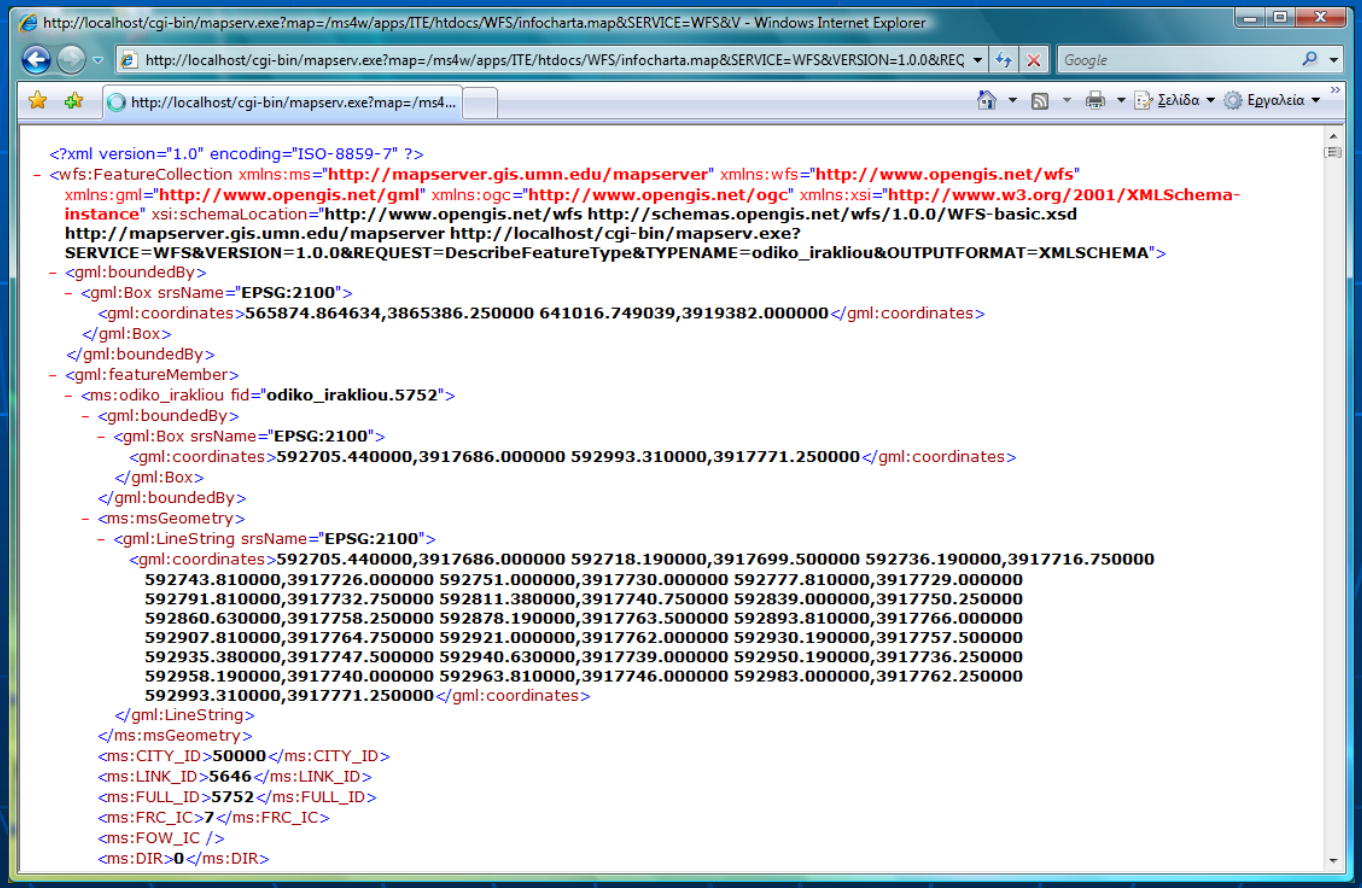
Heraklion SDI

- The Web Feature Service (WFS)…
  - GetFeature request

```
http://localhost/cgi-bin/mapserv.exe?
map=/ms4w/apps/ITE/htdocs/WFS/infocharta.map&
SERVICE=WFS&VERSION=1.0.0&
REQUEST=GetFeature&
typename=odiko_irakliou
```

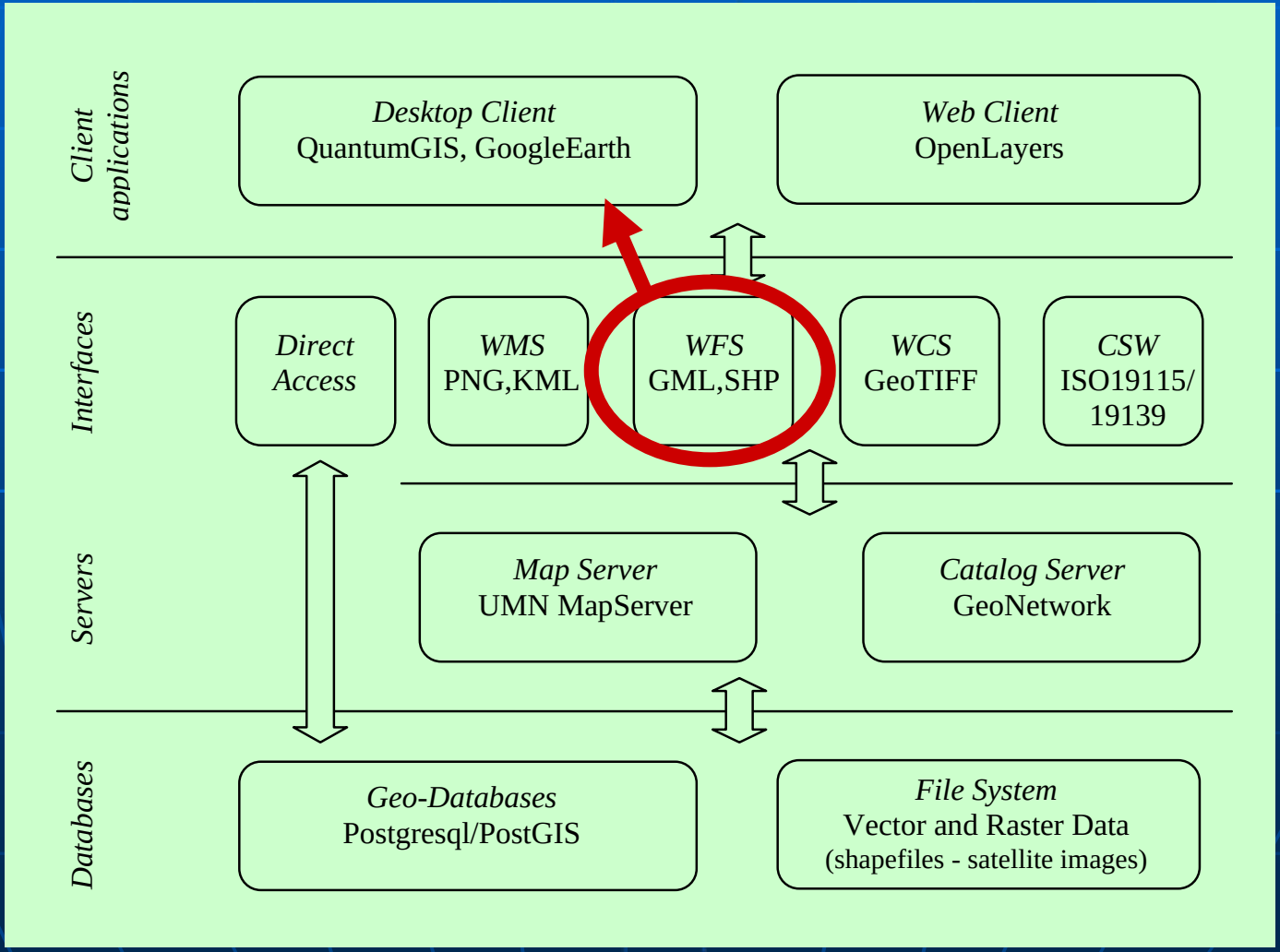
Heraklion SDI

- The Web Feature Service (WFS)…
  - GetFeature request



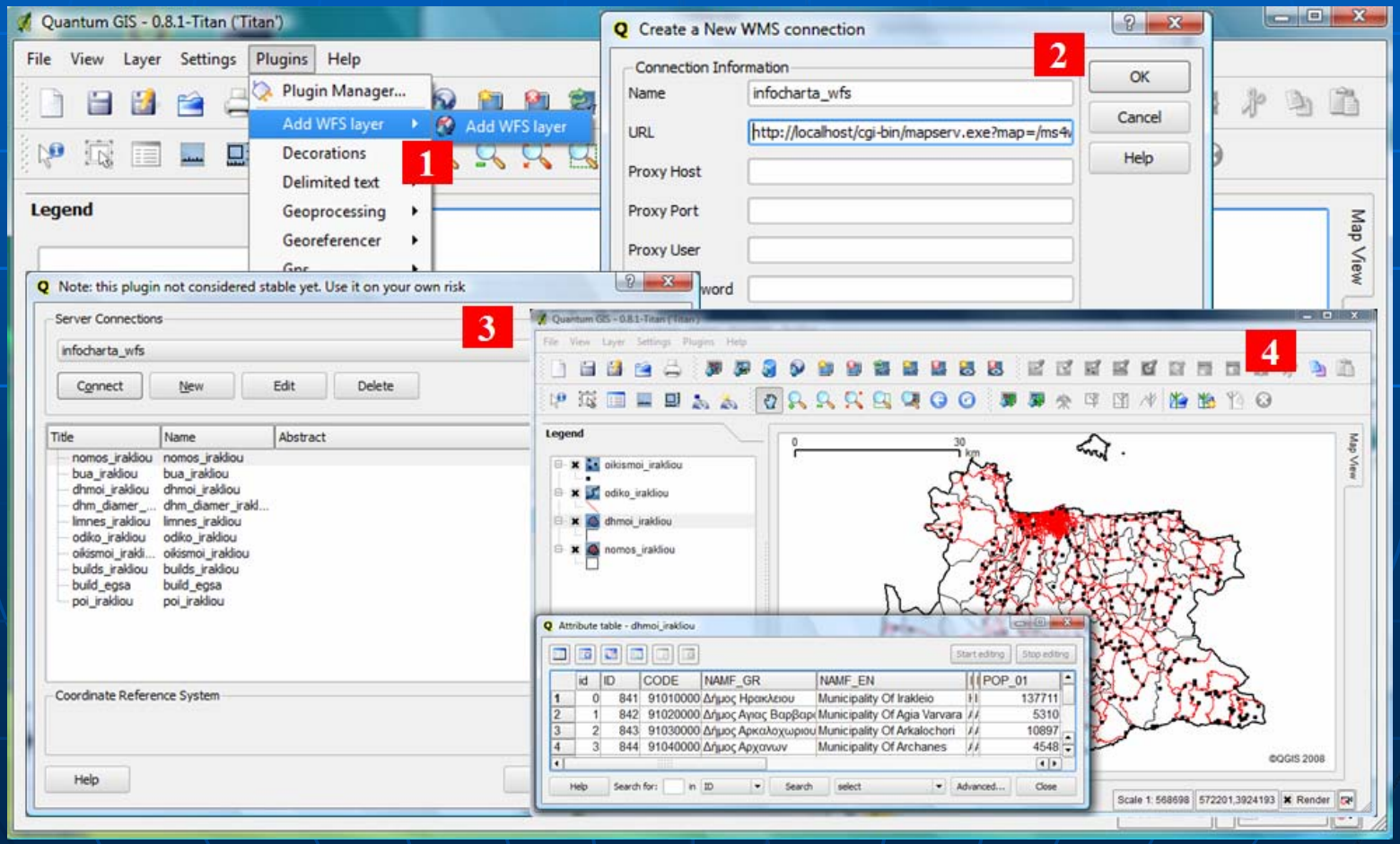
Architecture & Software Systems

- The architecture...



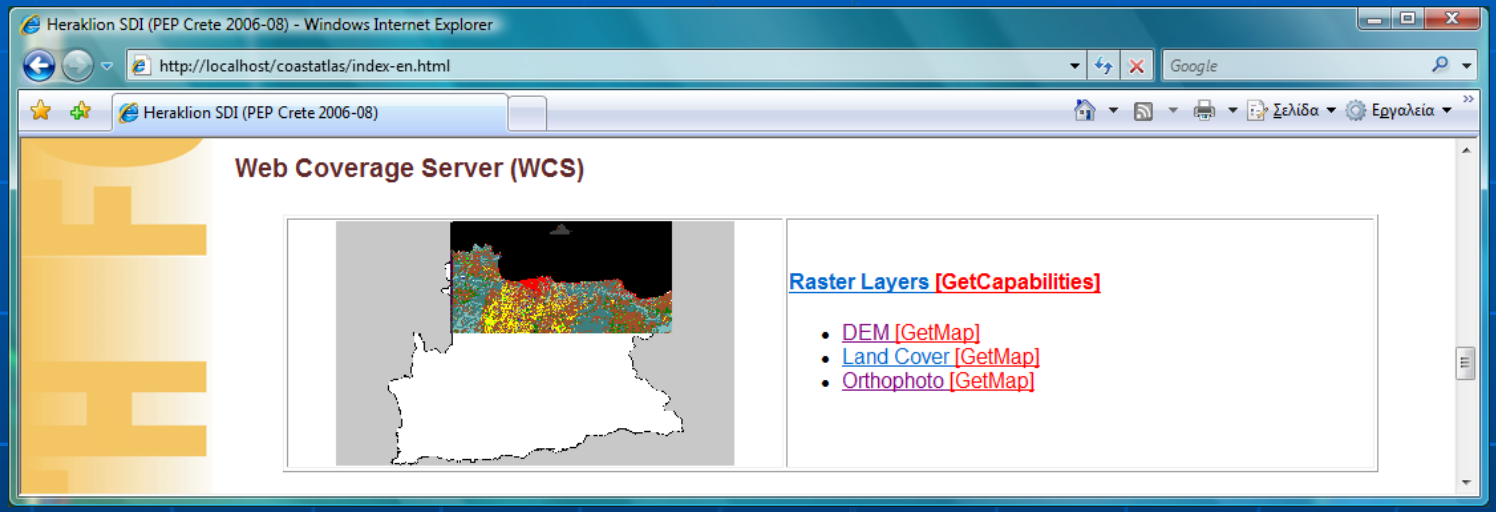
Heraklion SDI

- The Web Feature Service (WFS)…
  - QGIS: Connect to the WFS



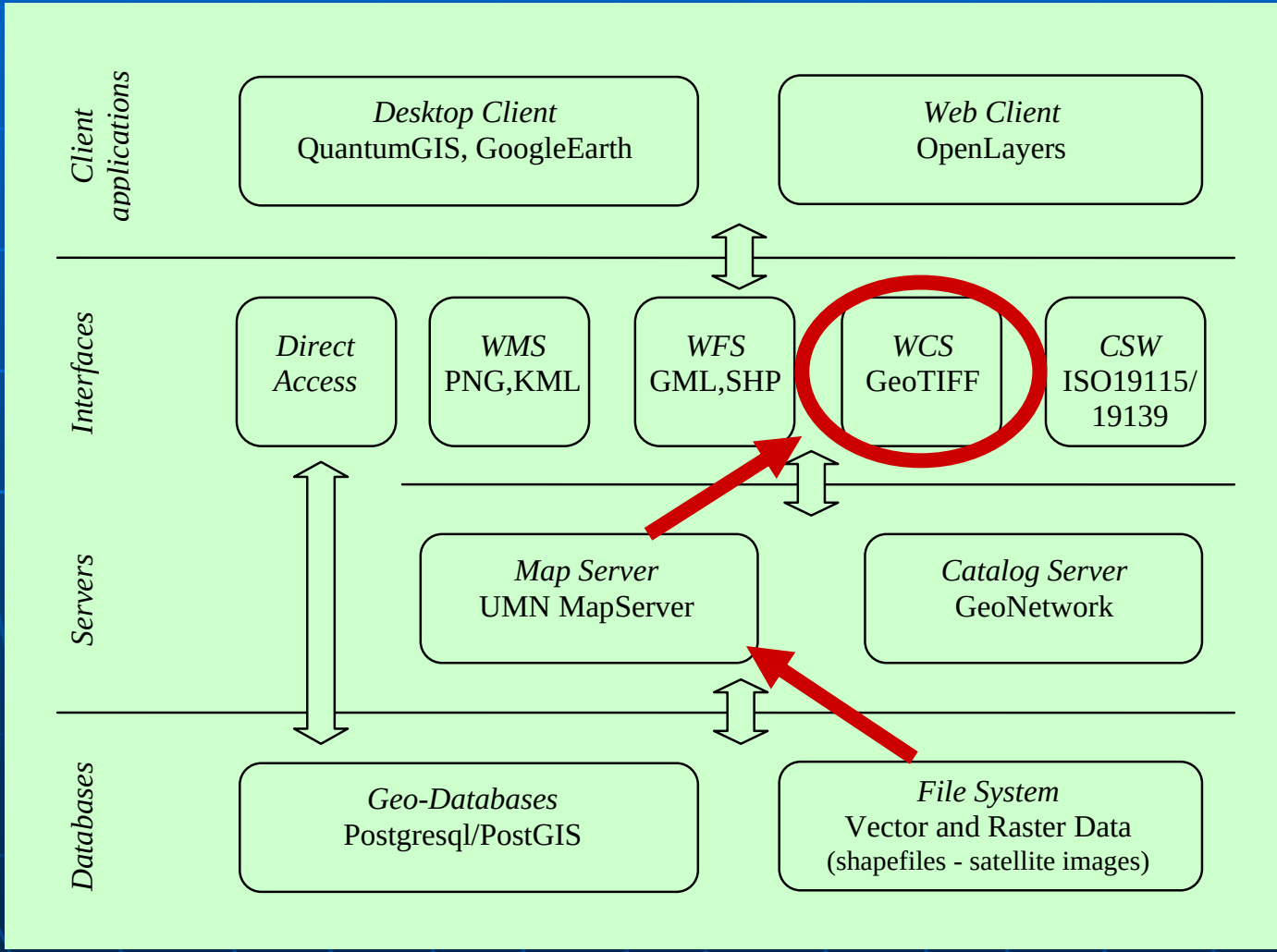
Heraklion SDI

- The Web Coverage Service (WCS)...



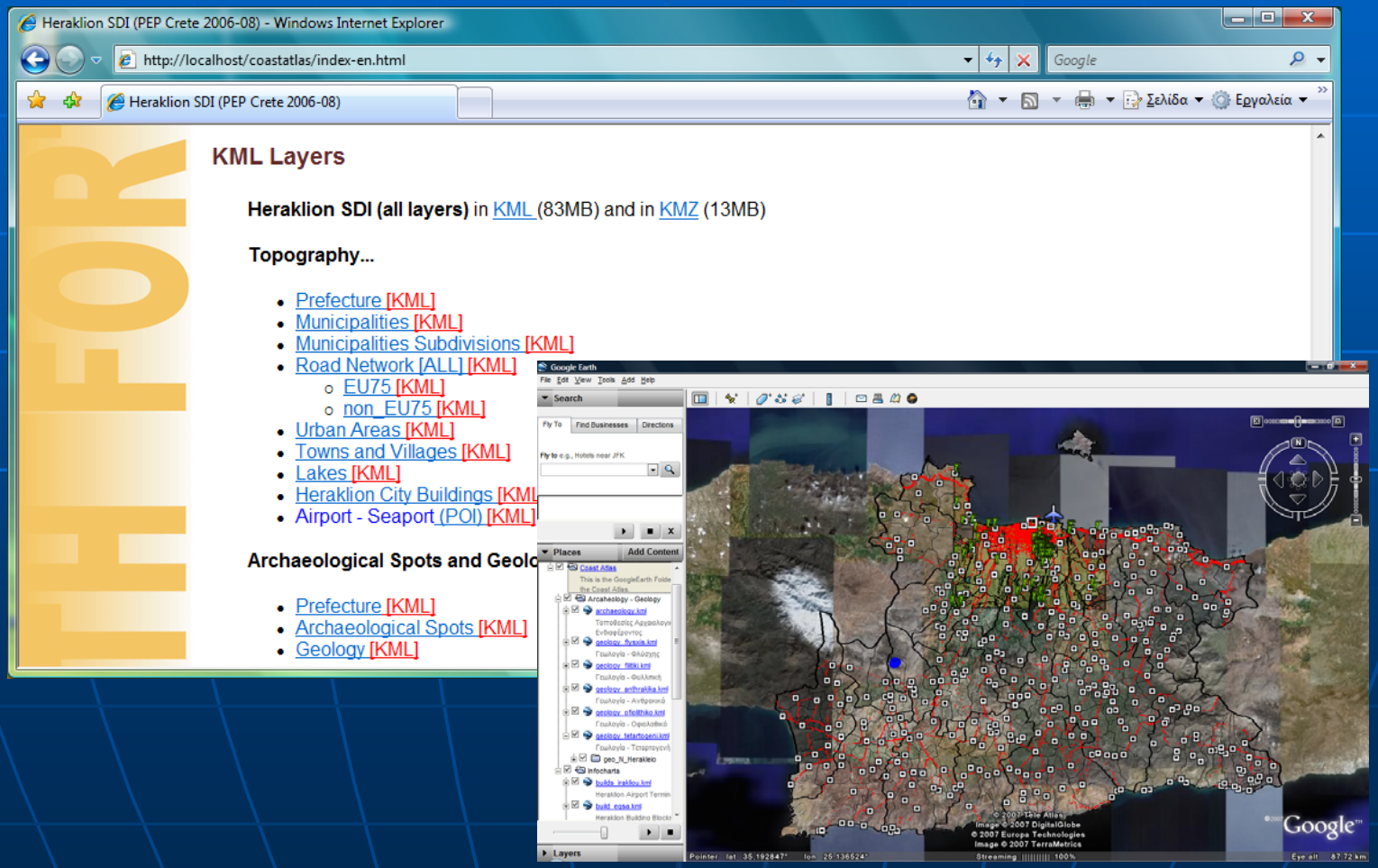
Architecture & Software Systems

- The architecture...



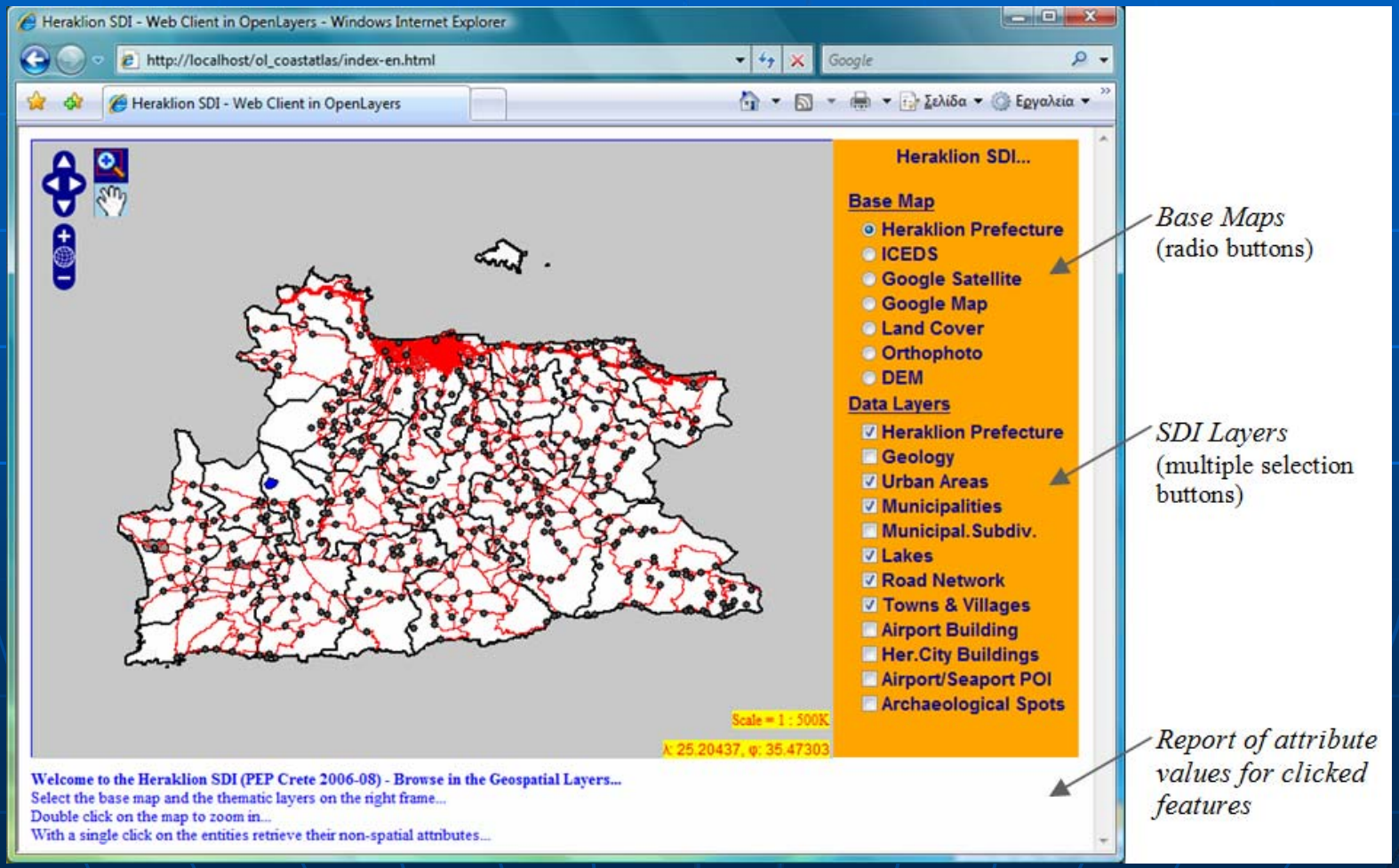
Heraklion SDI

- The KML Server...



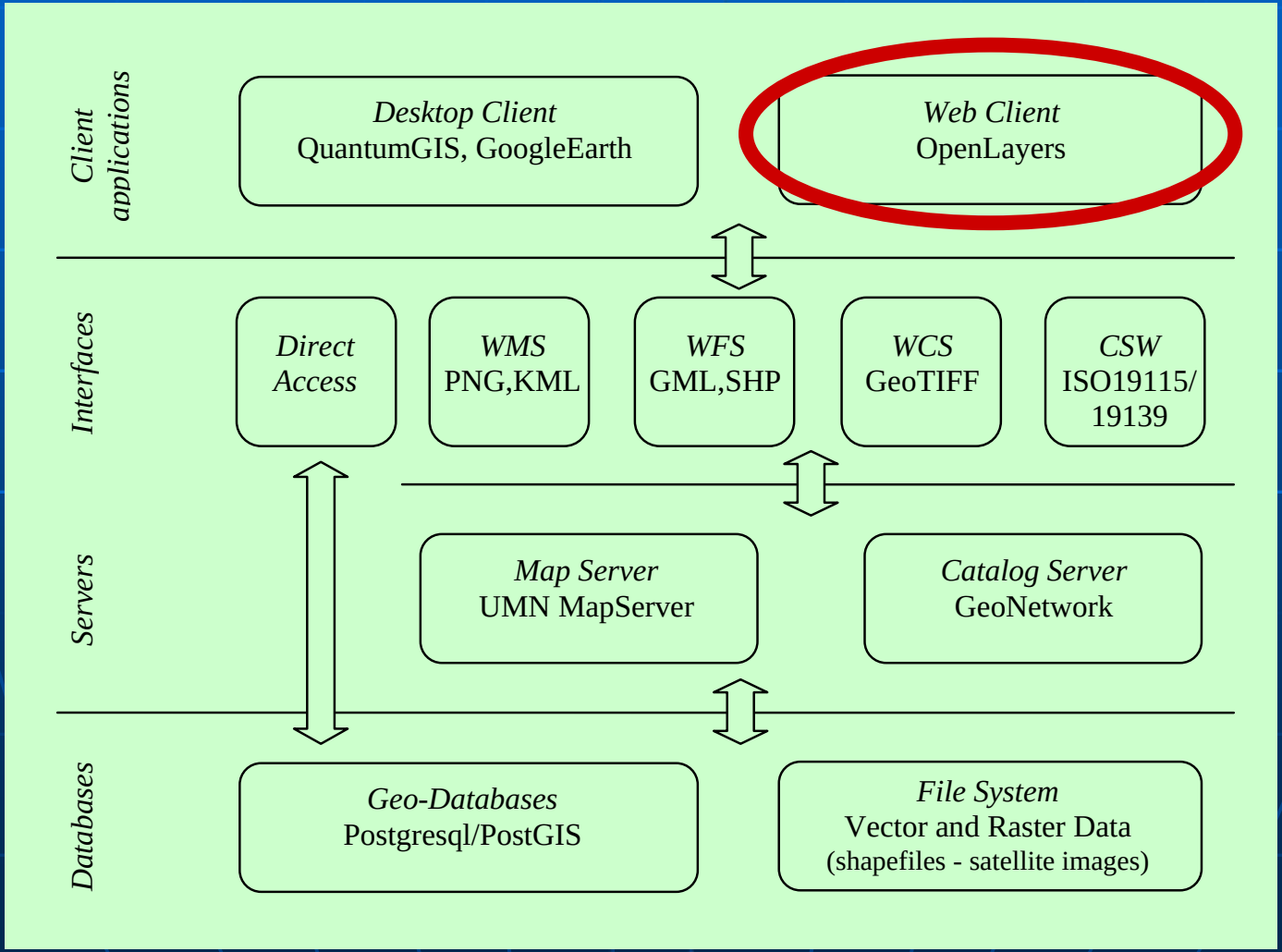
Heraklion SDI

- The Web Client Application ...



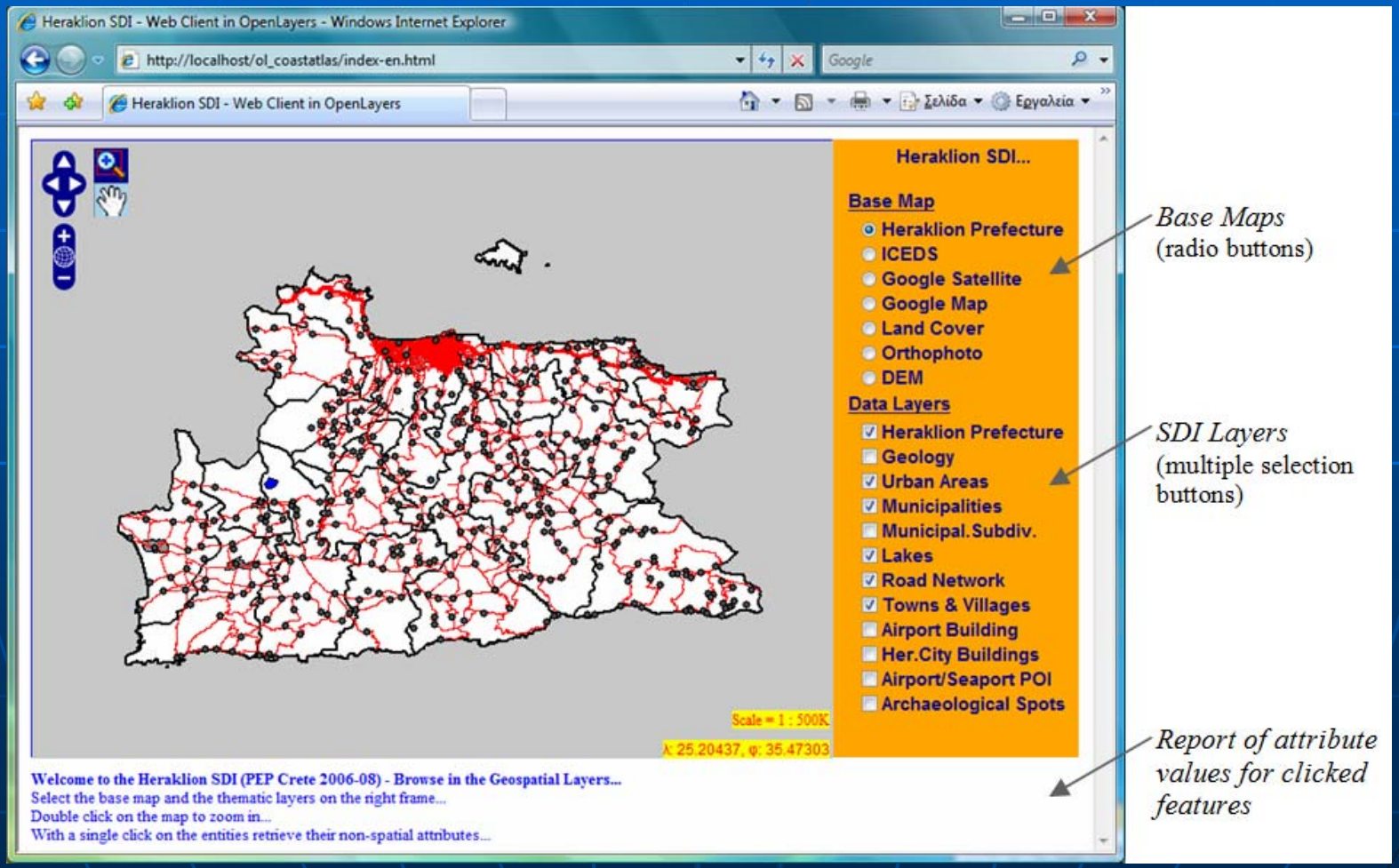
Architecture & Software Systems

- The architecture...



Heraklion SDI

- The Web Client Application ...



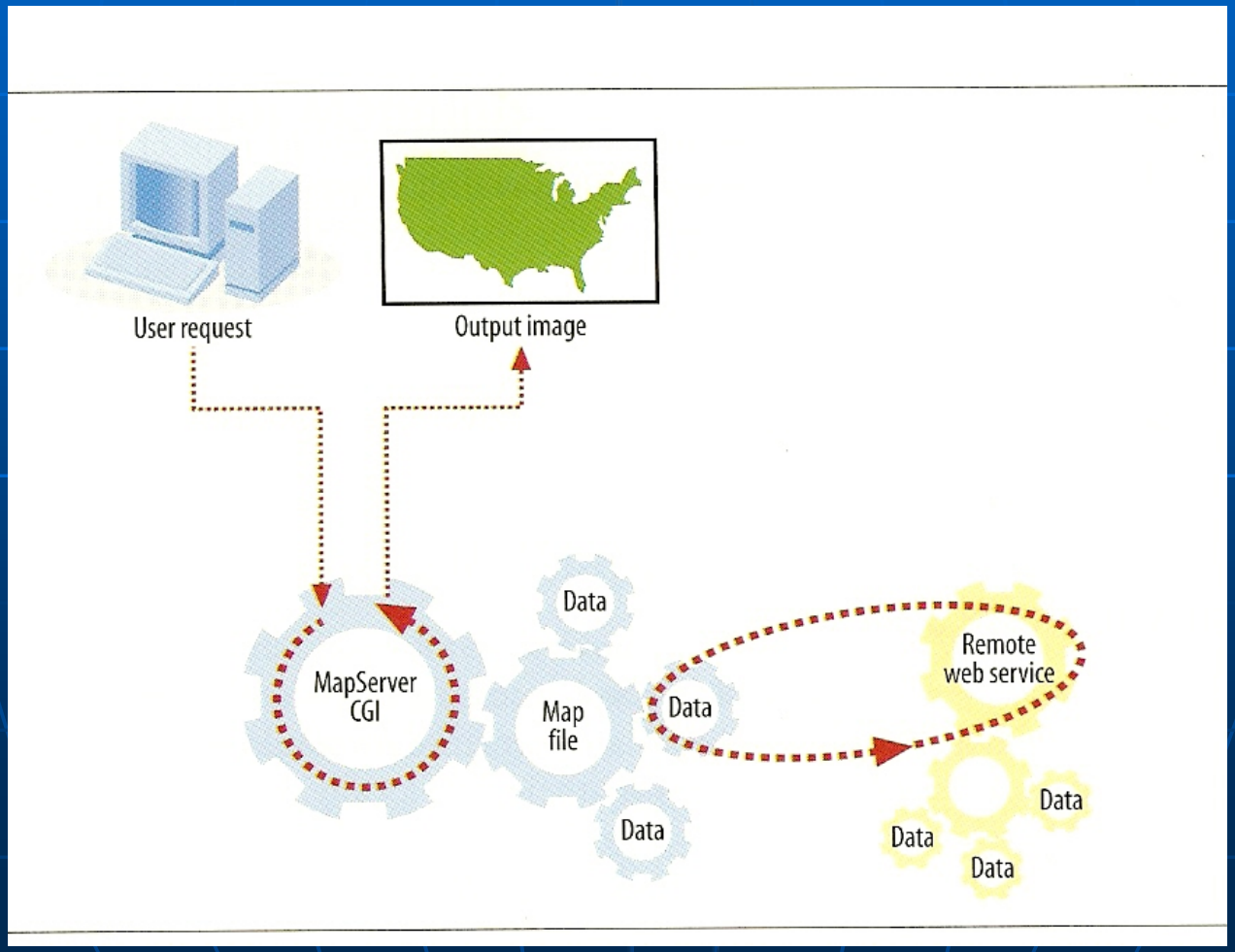
Heraklion SDI

- The Web Map Service (WMS)…
  - GetFeatureInfo request

```
dhmoi_irakliou.getFullRequestString({
REQUEST: "GetFeatureInfo",
EXCEPTIONS: "application/vnd.ogc.se_xml",
BBOX: dhmoi_irakliou.map.getExtent().toBBOX(),
X: e.xy.x, Y: e.xy.y,
INFO_FORMAT: "text/html",
FONT: "c:/ms4w/fontlist/times.ttf",
ENCODING: "ISO-8859-7",
QUERY_LAYERS: dhmoi_irakliou.params.LAYERS,
WIDTH: dhmoi_irakliou.map.size.w,
HEIGHT: dhmoi_irakliou.map.size.h});
```

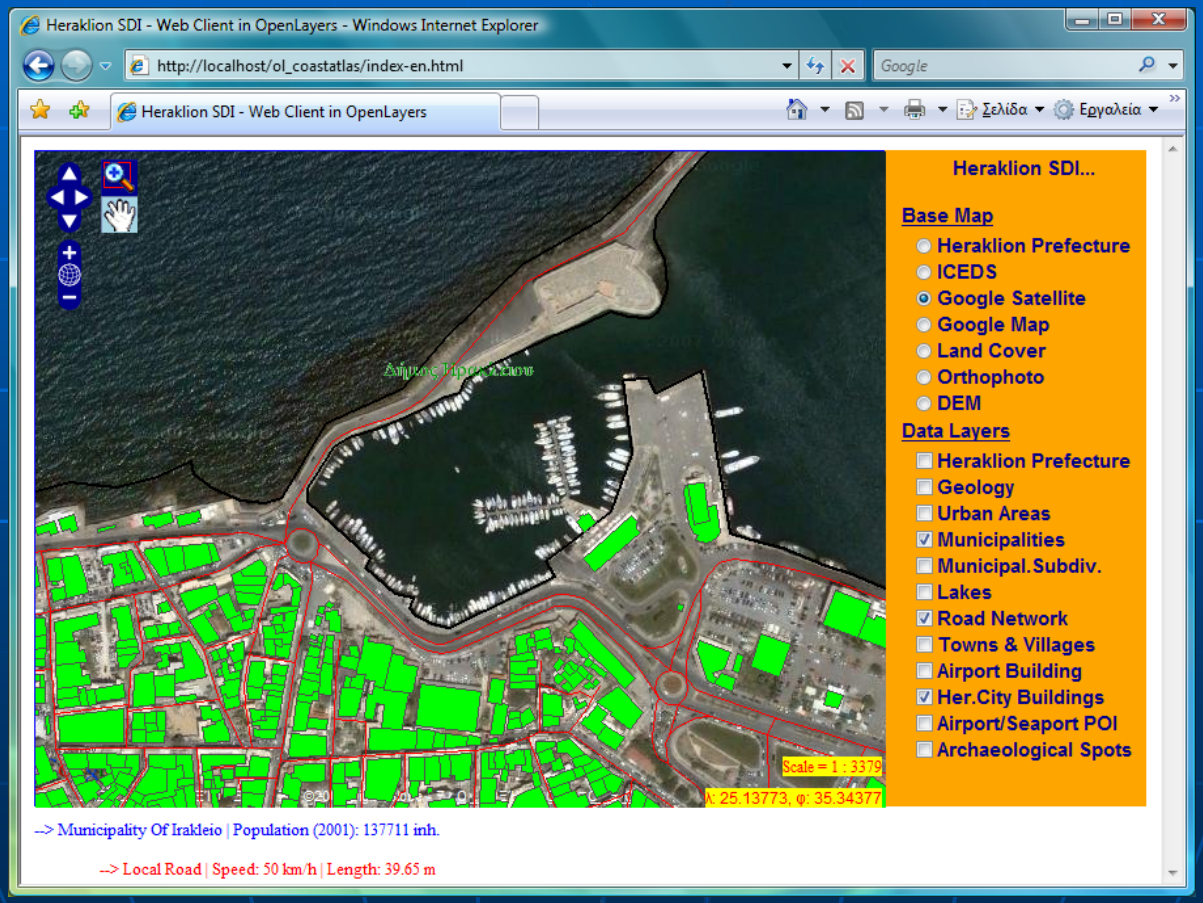
Heraklion SDI

- Mashups ...



Heraklion SDI

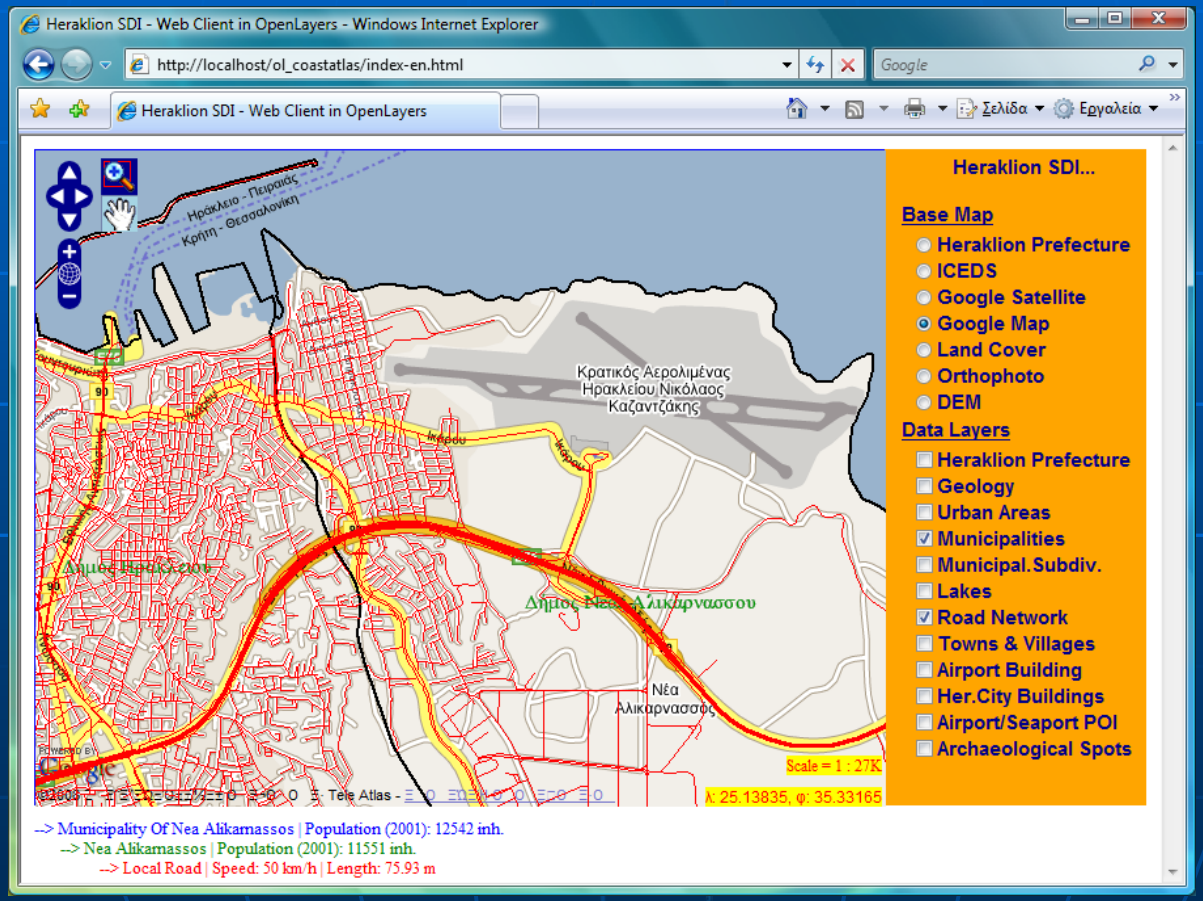
- Mashups ...



Base Map: Google Satellite
Layers: Municipalities, Road Network, Buildings

Heraklion SDI

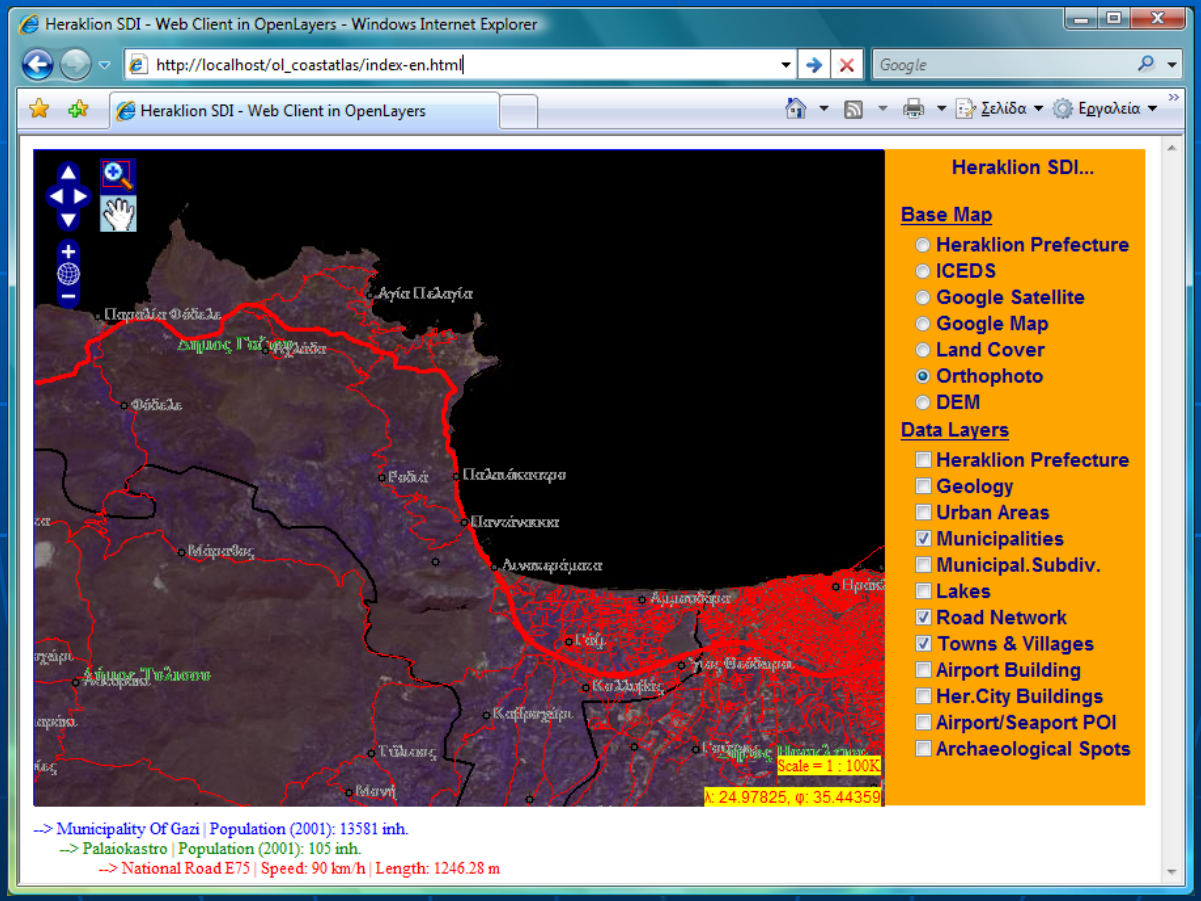
- Mashups ...



Base Map: Google Map
Layers: Municipalities, Road Network

Heraklion SDI

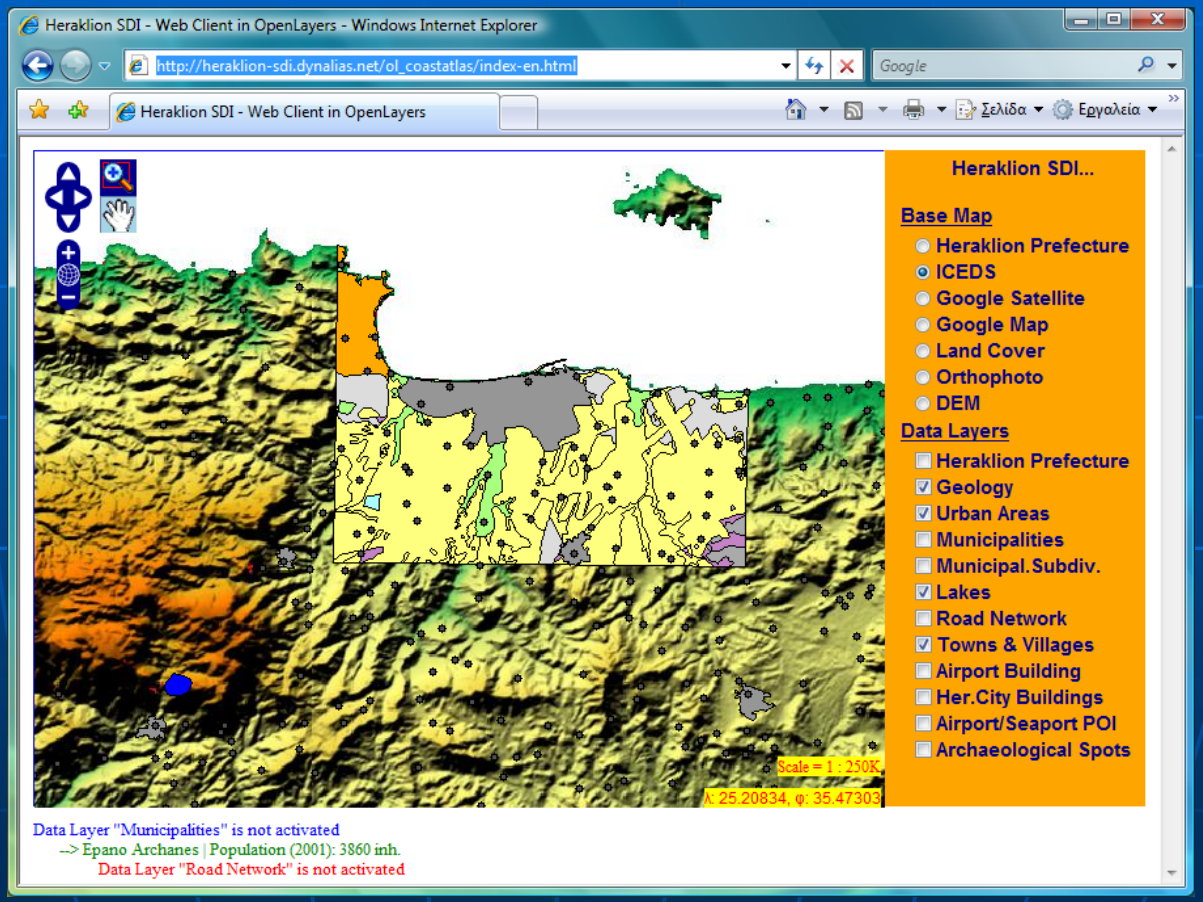
- Mashups ...



Base Map: Orthophoto Map
Layers: Municipalities, Towns, Road Network

Heraklion SDI

- Mashups ...



Integrated CEOS European Data Server

Base Map: ICEDS (WMS)
Layers: Geology, Urban areas, Towns, Lakes

Heraklion SDI

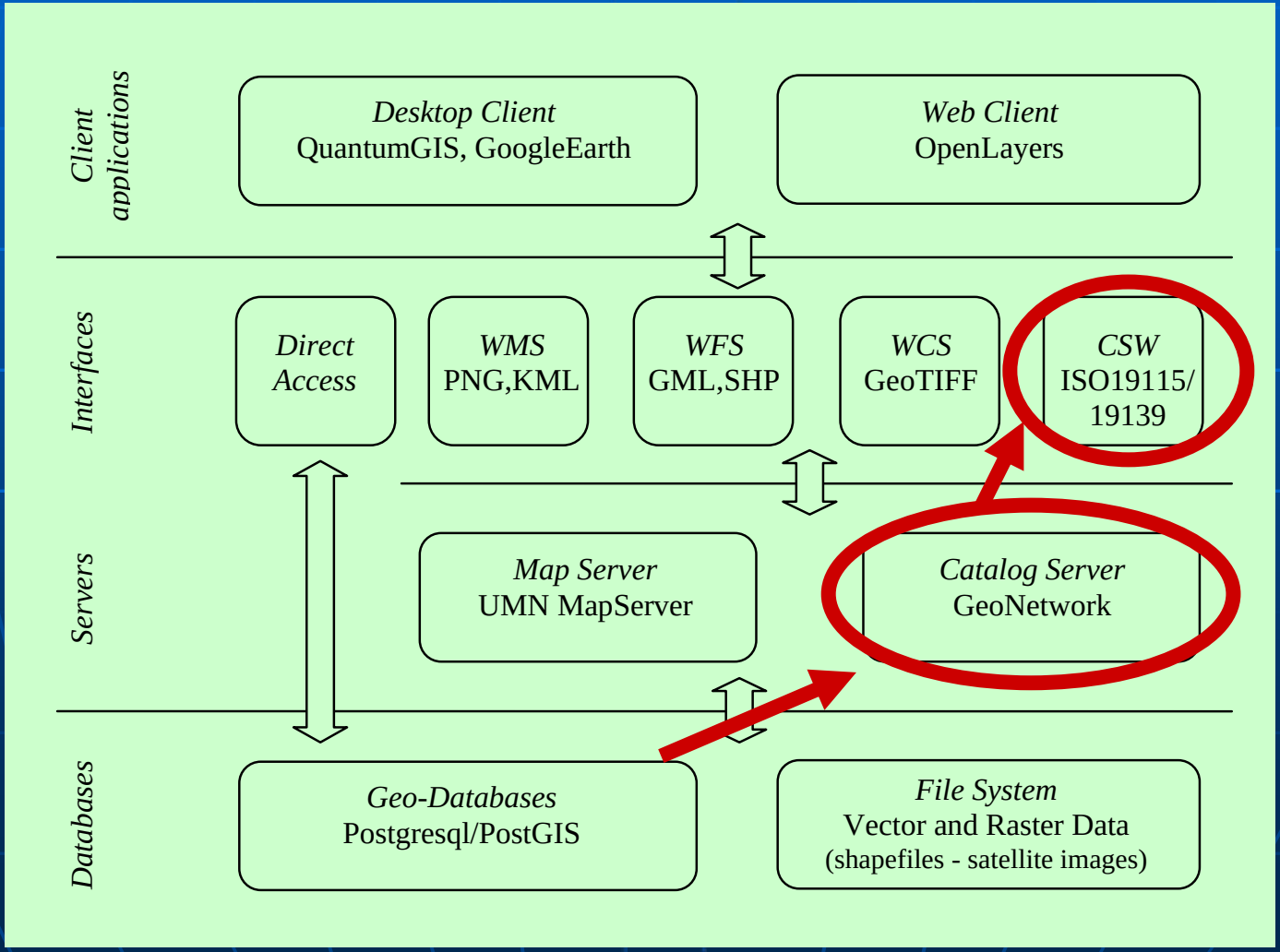
- The Catalog Server ...
  - Heraklion SDI accommodates...
    - a wide digital content of **various types and formats**
      - geospatial data layers
      - satellite images
      - web mapping applications and services

Heraklion SDI

- The Catalog Server ...
  - to make this content accessible on the web and assure its usability,
    - appropriate **metadata items** must be generated
    - a **data catalog server** is needed
      - to make the metadata items available on the web
      - support the efficient discovery and evaluation of the SDI content

Architecture & Software Systems

- The architecture...



Heraklion SDI

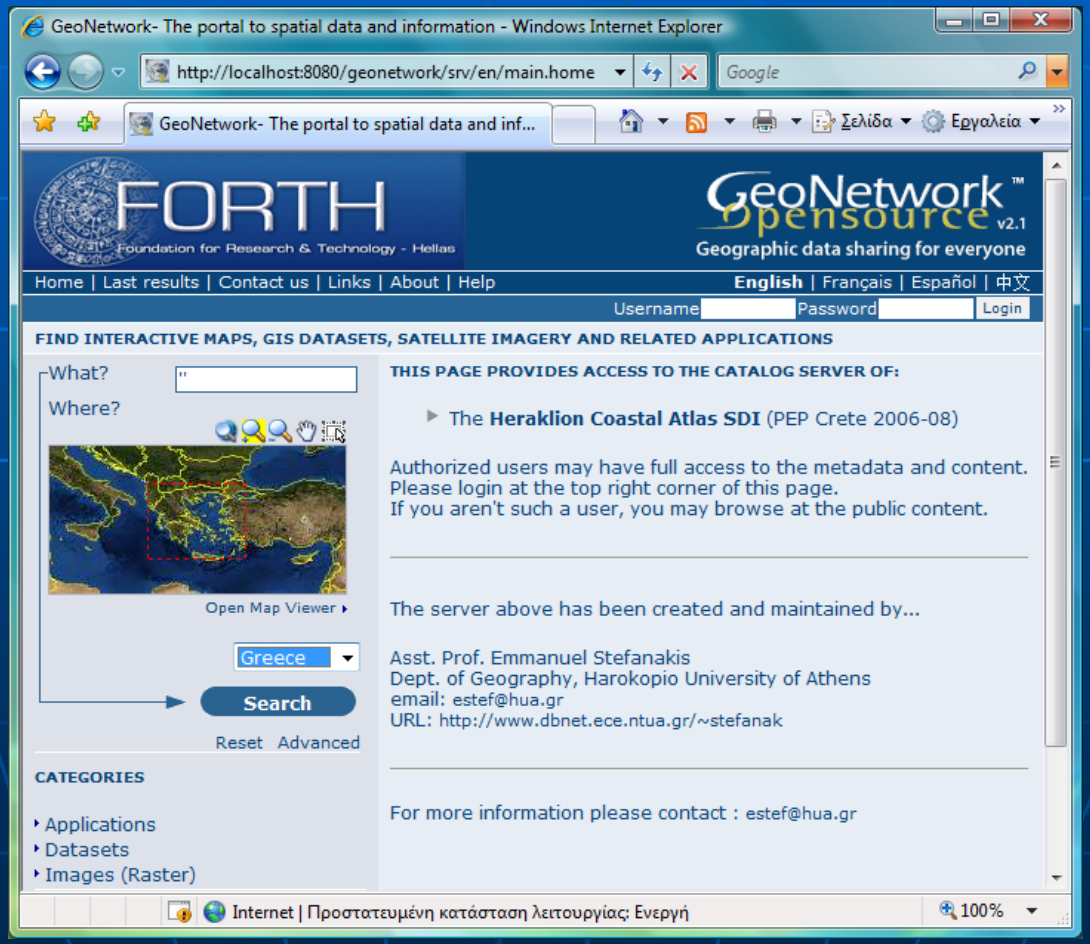
- The Catalog Server ...
  - The content items of the SDI ...
    - have been assigned appropriate metadata items in **XML format**
    - according to the specification of a customized **ISO19139 template**

Heraklion SDI

- The Catalog Server ...
  - ... then a catalog server has been implemented using **GeoNetwork Opensource Server** software ver. 2.1
  - The configuration adopted utilizes
    - the **PostgreSQL** in the role of the DBMS server and
    - the **Apache Tomcat v5.5** in the role of the Web Server.

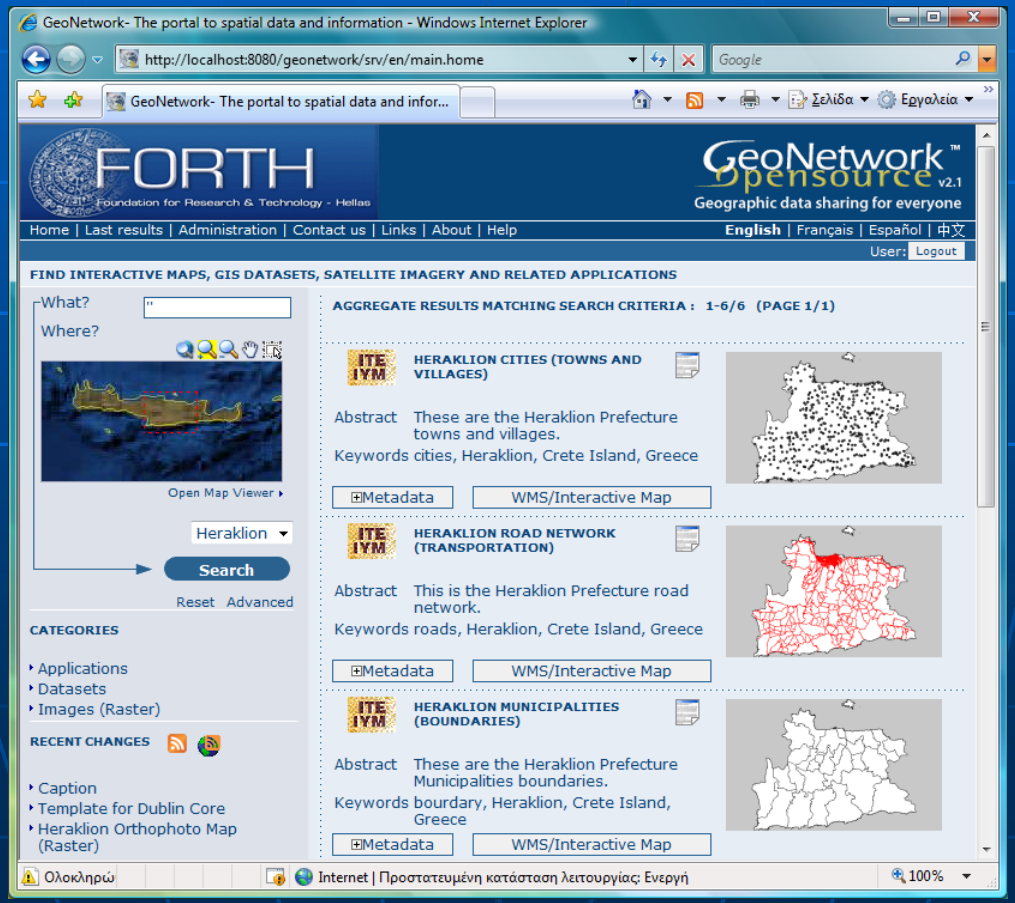
Heraklion SDI

- The Catalog Server ...



Heraklion SDI

- The Catalog Server …



Heraklion SDI

- The Catalog Server ...

Heraklion SDI

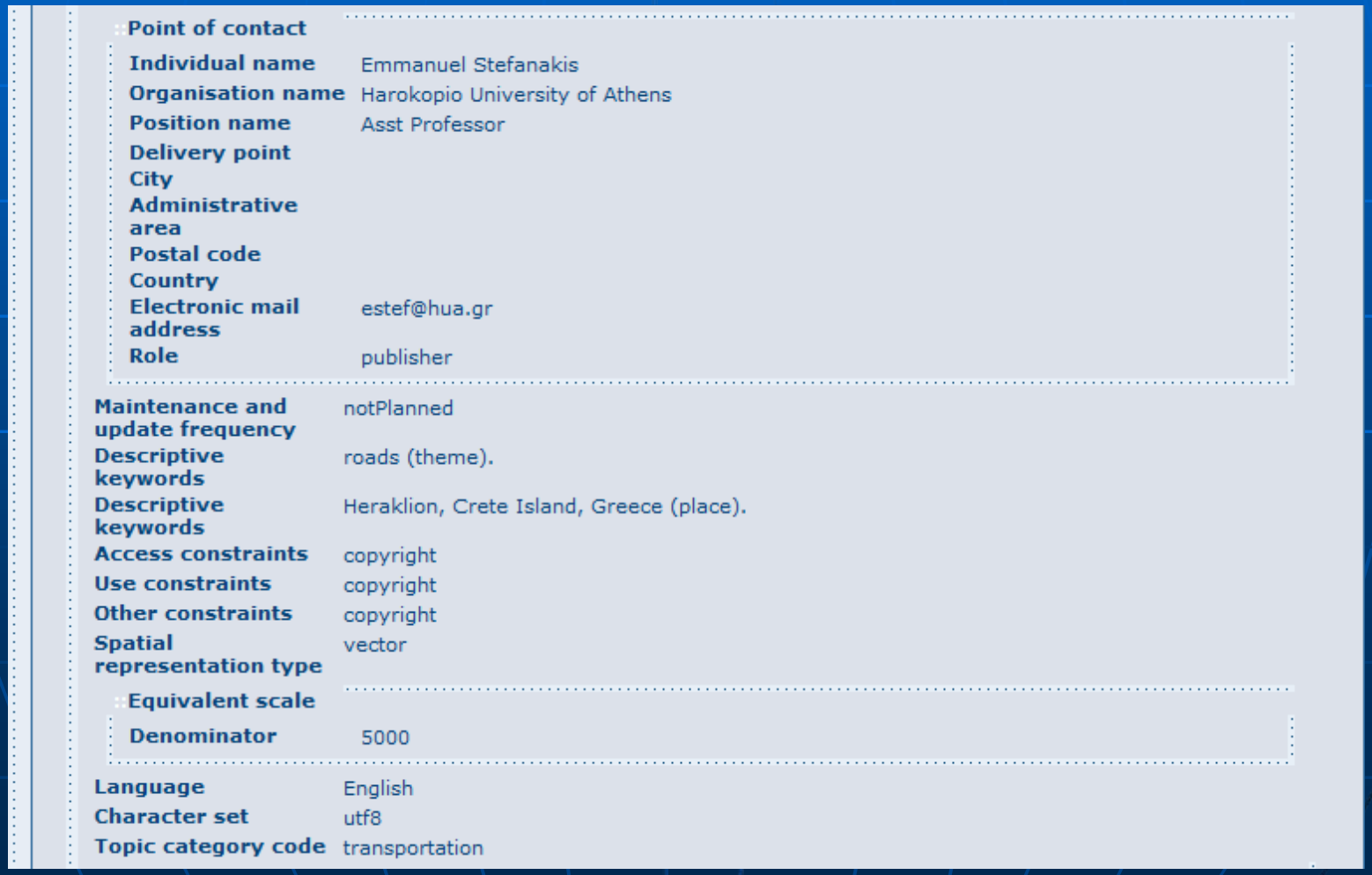
- The Catalog Server …

Heraklion SDI

- The Catalog Server ...

Heraklion SDI

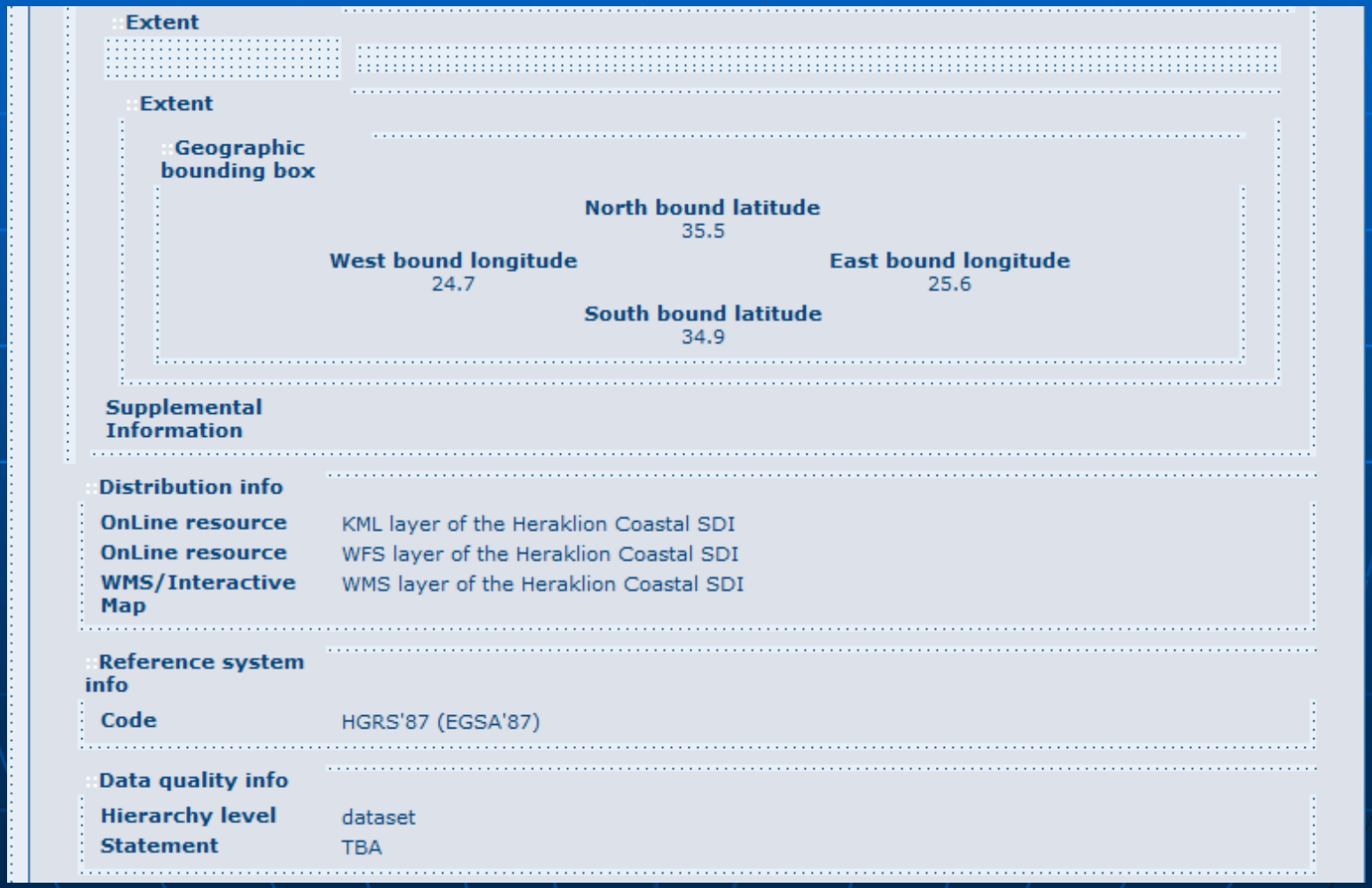
- The Catalog Server ...



Point of contact	
Individual name	Emmanuel Stefanakis
Organisation name	Harokopio University of Athens
Position name	Asst Professor
Delivery point	
City	
Administrative area	
Postal code	
Country	
Electronic mail address	estef@hua.gr
Role	publisher
Maintenance and update frequency	notPlanned
Descriptive keywords	roads (theme).
Descriptive keywords	Heraklion, Crete Island, Greece (place).
Access constraints	copyright
Use constraints	copyright
Other constraints	copyright
Spatial representation type	vector
Equivalent scale	
Denominator	5000
Language	English
Character set	utf8
Topic category code	transportation

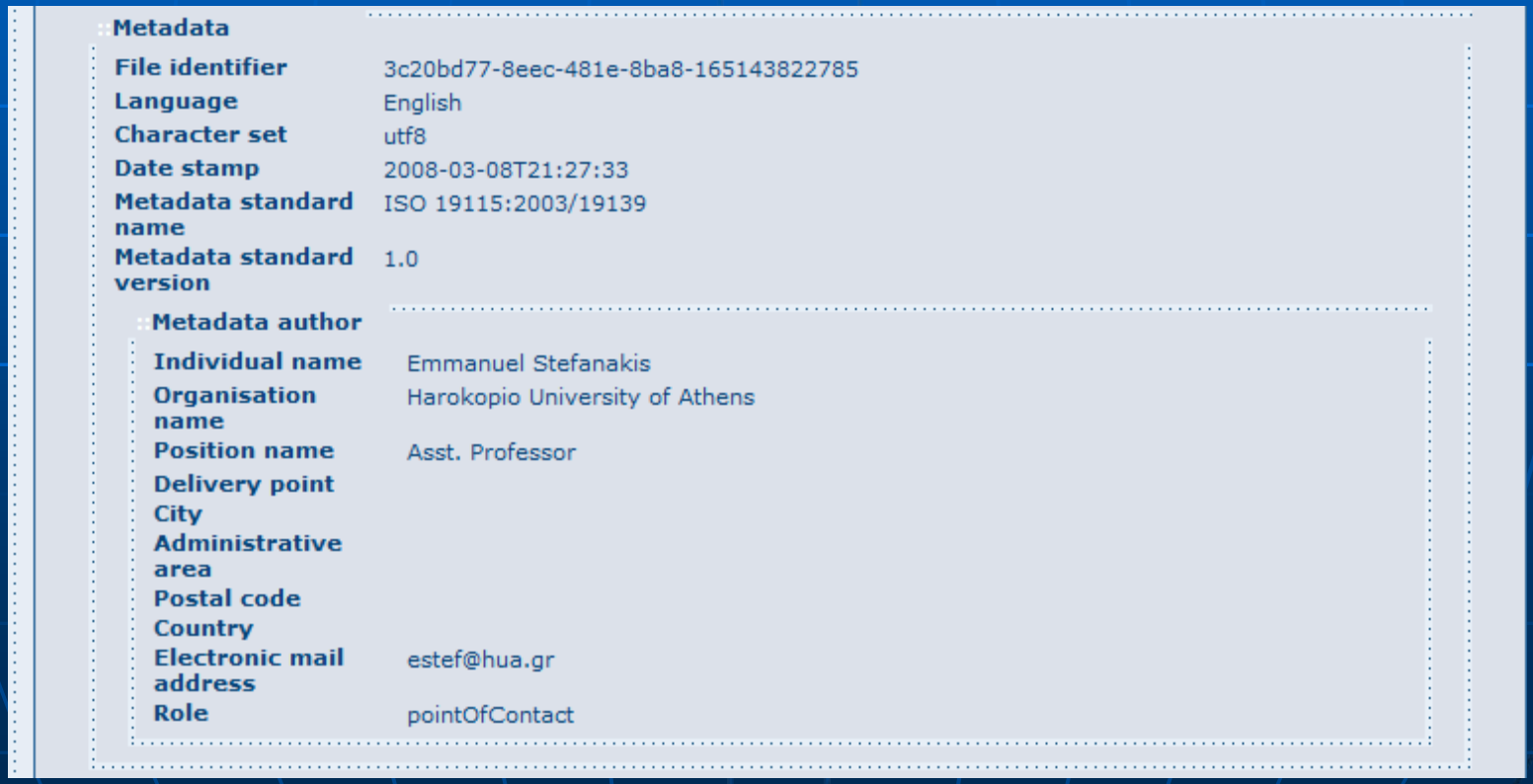
Heraklion SDI

- The Catalog Server ...



Heraklion SDI

- The Catalog Server ...



Metadata

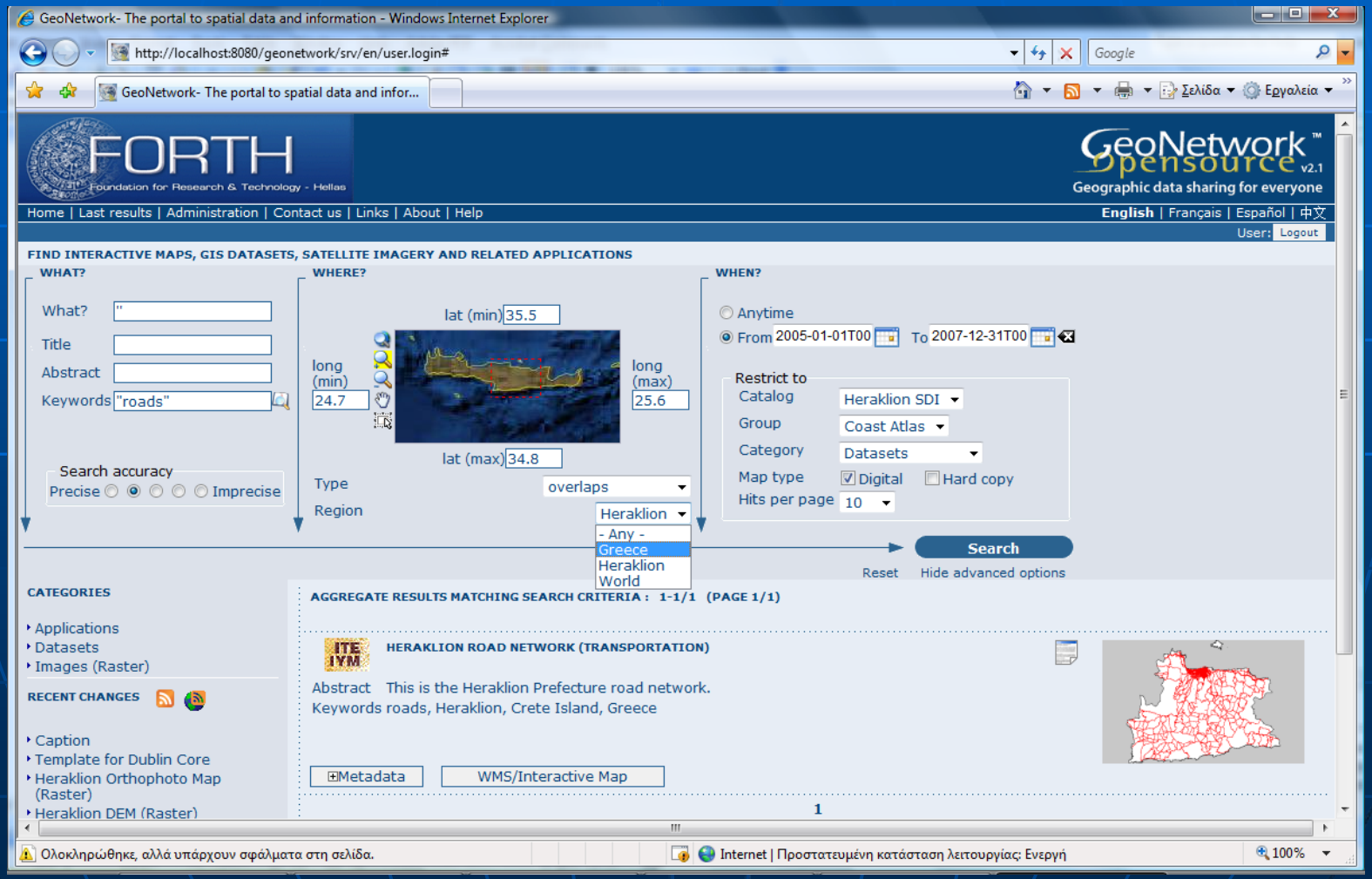
File identifier	3c20bd77-8eec-481e-8ba8-165143822785
Language	English
Character set	utf8
Date stamp	2008-03-08T21:27:33
Metadata standard name	ISO 19115:2003/19139
Metadata standard version	1.0

Metadata author

Individual name	Emmanuel Stefanakis
Organisation name	Harokopio University of Athens
Position name	Asst. Professor
Delivery point	
City	
Administrative area	
Postal code	
Country	
Electronic mail address	estef@hua.gr
Role	pointOfContact

Heraklion SDI

- The Catalog Server ...



Η Διαλειτουργικότητα στη Γεωγραφική Πληροφορία

OGC® Open Geospatial Consortium, Inc.

www.opengeospatial.org

Παρασκευή
03/04/2009

Ledra Marriott Hotel

Hellas G.I.S

www.hellasgi.gr

Development of an Open Source-based Regional SDI for Heraklion Prefecture

Ευχαριστώ! Thank you !

Emmanuel Stefanakis & Poulicos Prastacos

Harokopio University of Athens
Department of Geography
estef@hua.gr

FORTH & InfoCharta Ltd
STEP-C, Heraklion
poulicos@iacm.forth.gr