# SDI:
# SOA Architecture and Web services

**Diederik Tirry**
**Spatial Applications Division Leuven**
**SADL/K.U.Leuven R&D**

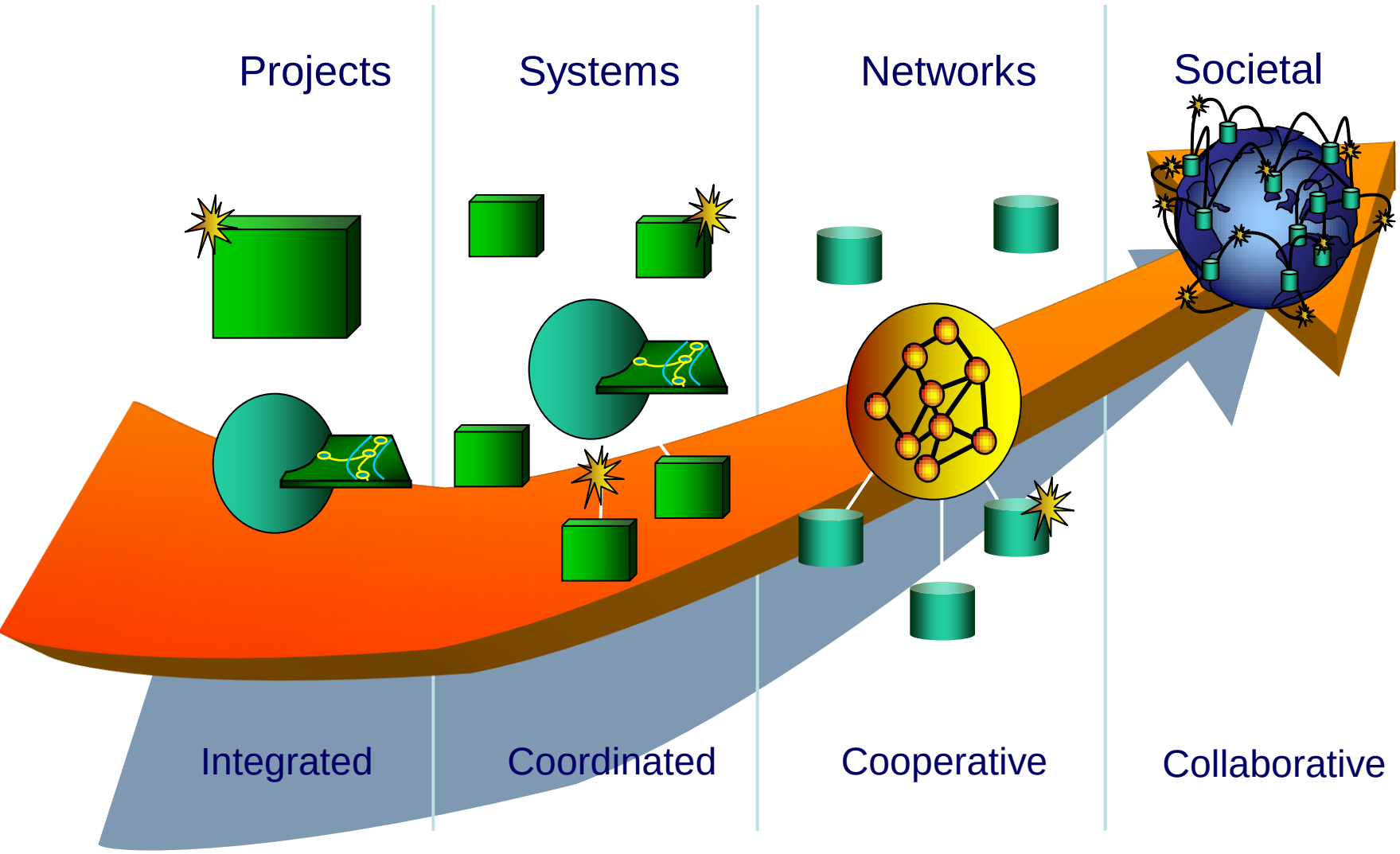
**Acknowledgement to**
**Danny Vandenbroucke, Paul Jacxsens**

08-11-2011

# Outline

- Technological trends
- Introduction to Web Services
- Open Standards
- OGC Standards
  - Web Map Services (WMS)
  - Web Feature Services (WFS)
  - Catalogue Service for the web (CSW)
  - Web Processing Service (WPS)
  - Sensor Observation Service (SOS)
  - Geographic Markup Language (GML)
  - Styled Layer Descriptor (SLD)
- Open Source & ESRI GIS clients & servers

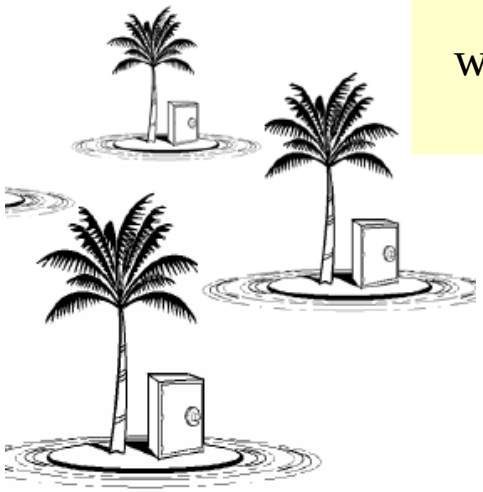
# GIS is (rapidly) evolving



# System Integration

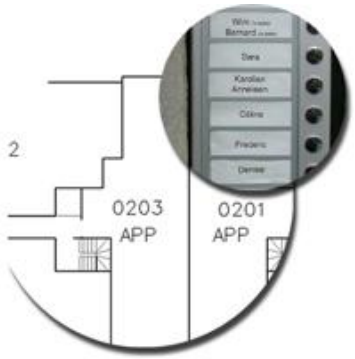
- Often systems exist in organisation as separate silo's
  - Even GIS applications often exist on their own
  - Even less are GIS applications integrated within the overall ICT environment and its applications, and the business processes they support

A permit system using an Oracle database developed with PowerBuilder software can communicate with a .NET based tax system to determine first if a permit applicant has paid their tax bill, then if the property is within a certain distance of a floodplain or wetland, which would in turn determine the permit process and fees.



# System Integration

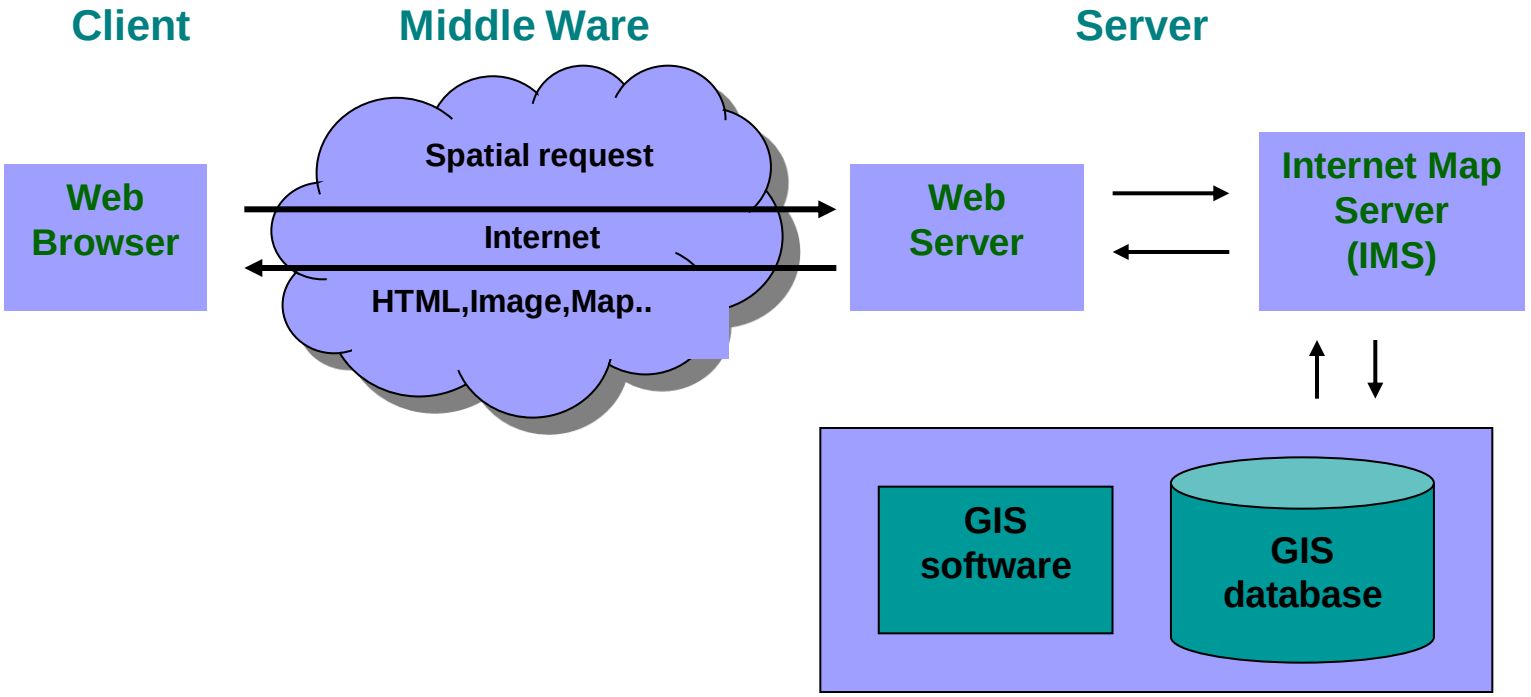
- By integrating with traditional IT, existing workflows and backend systems, GI will add value to the system
  - E.g. integrate with SAP systems (accountancy)
- GIS can even become the backbone of all the information treated in one organisation
  - E.g. City of Leuven (G@lileo)





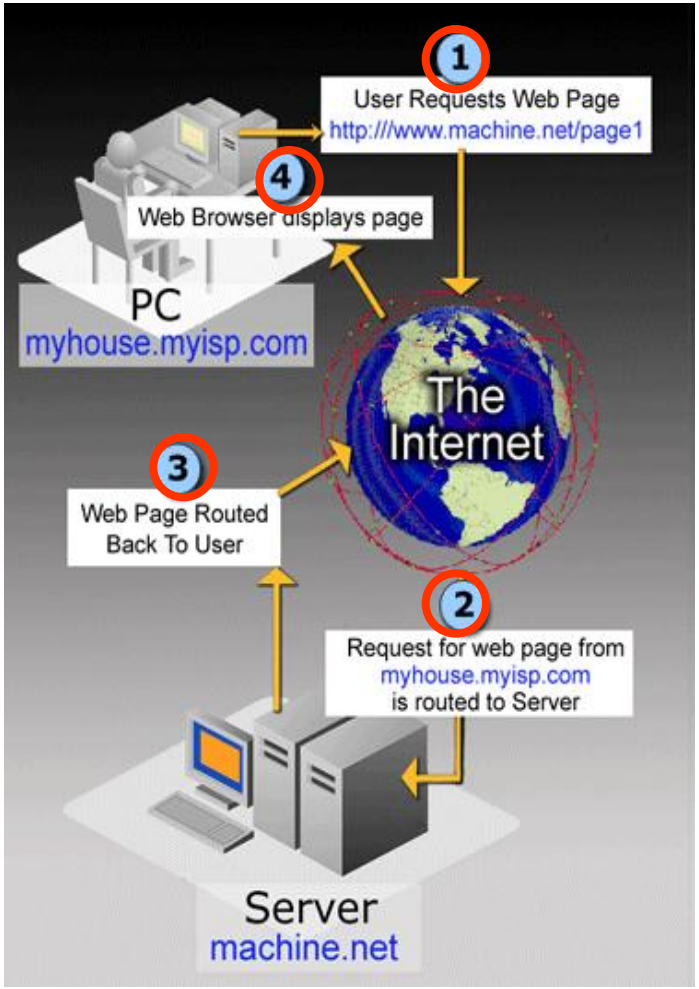
# SOA and Grid computing

- Client – Server Architecture
  - Server “serves” the client
    - Providing bits of information (first processing or processing by client)
  - Typical three tier architecture
    - Presentation tier: Contains user interface
    - Application logic tier: Model & process GIS data
    - Storage tier: Databases that store GIS data



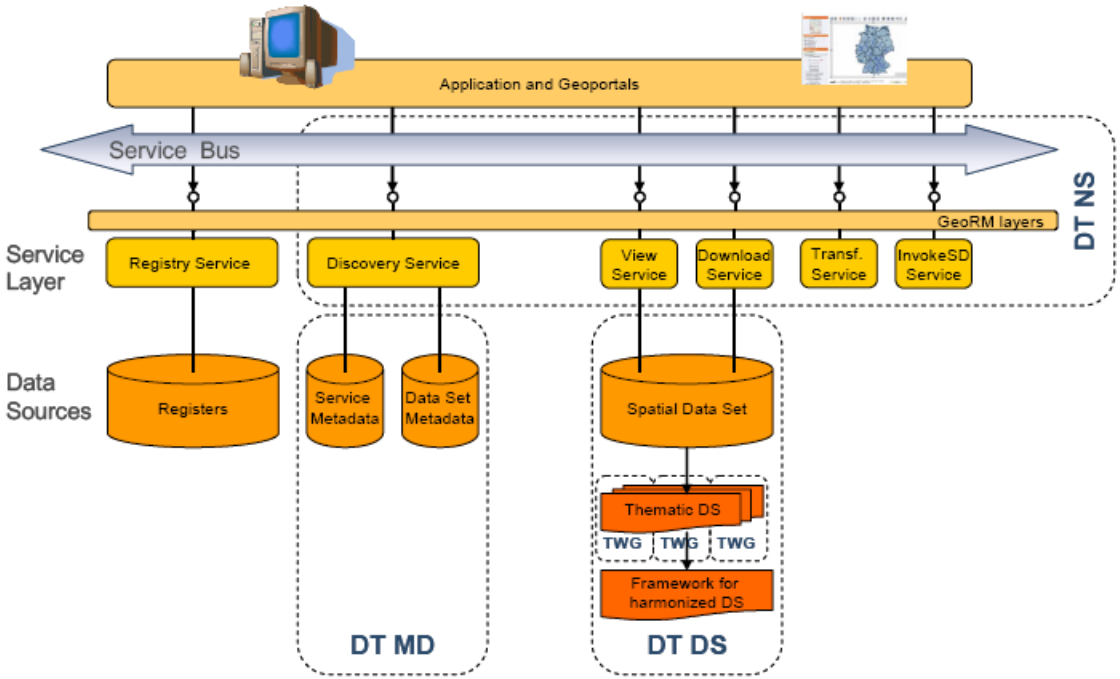
# How the Web works...

Client-server model



# Service-Oriented Architecture

- Method for systems development and integration where functionality is grouped around business processes and packaged as interoperable services.
- SOA also describes IT infrastructure which allows different applications to exchange data with one another as they participate in business processes.
- The aim is a loose coupling of services with operating systems, programming languages and other technologies which underlie applications.




Source: [Wikipedia]

GOBIERNO DE ESPAÑA | MINISTERIO DE FOMENTO

Consejo Superior Geografico

# Infraestructura de Datos Espaciales de España

navigation map contact

IDEE

**Spanish IDE**
- IDEE Project
- IDEE workgroup
- SDIs and GIS in Spain

**IDEE Contributions**
- How to contribute?

**Services**
- Catalogue
- Map Viewer
- Data download
- Search for geographical names
- CORINE
- Measurement of altitude
- Coordenate Transformation Service

**Resources**
- Free Software Tools
- Metadata desing
- Spatial Reference System
- Developer site
- Google Earth

Select your regional Spatial Data Infrastructure:

idee@ign.es
blogIDEE
RSS

The term "Spatial Data Infrastructure" (SDI) is often used to denote the relevant base collection of technologies, policies and institutional arrangements that facilitate the availability of and access to spatial data. The SDI provides a basis for spatial data discovery, evaluation, and application for users and providers within all levels of government, the commercial sector, the non-profit sector, academia and by citizens in general (**www.idee.es**).

The word infrastructure is used to promote the concept of a reliable, supporting environment, analogous to a road or telecommunications network, that, in this case, facilitates the access to geographically-related information using a minimum set of standard practices, protocols, and specifications. The applications that run "on" such an infrastructure are not specified in detail in this document. But, like roads and wires, an SDI facilitates the conveyance of virtually unlimited packages of geographic information.

## Services

- Map Viewer
- Data Catologue
- Search for geographical names
- Download Data
- Territory Analysis
- Simbology Maker
- Land Cover (CORINE)
- Coordenate Transformation Service
- Elevation Analysis

**Documents**

2008-02-28
Real Decree 1545/2007 del National Cartographic System (BOE 30-11-2007)
2005-12-10
Spanish Gazetteer Model

**Latest News**

2008-08-08
Services and IDEE Portal maintenance
2008-08-07
Available August IDEs Bulletin
2008-07-31
The V Conference

International

INSPIRE

**Spatial Data Infrastructures**

# Outline

- Technological trends
- Introduction to Web Services
- Open Standards
- OGC Standards
  - Web Map Services (WMS)
  - Web Feature Services (WFS)
  - Catalogue Service for the web (CSW)
  - Web Processing Service (WPS)
  - Sensor Observation Service (SOS)
  - Geographic Markup Language (GML)
  - Styled Layer Descriptor (SLD)
- Open Source & ESRI GIS clients & servers

# Demos

- Minnesota Department of Nation Resources, Recreation Compass: http://www.dnr.state.mn.us/maps/compass.html
- Alp-Water-Scarce, Water Management Strategies against Water Scarcity in the Alps: http://maps.geo.sbg.ac.at:8080/aws/
- Barrow Borough Council Web Mapping: http://webgis1.barrowbc.gov.uk/webgis/bingis.html
- AGIV, GDI-Vlaanderen testbed: http://gditestbed.agiv.be/
  (GDI = Geografische Data Infrastructuur)
- Ruimtemonitor Vlaanderen: http://www.ruimtemonitor.be
- Intergovernmental Panel on Climate Change: http://www.ipcc-data.org/maps/

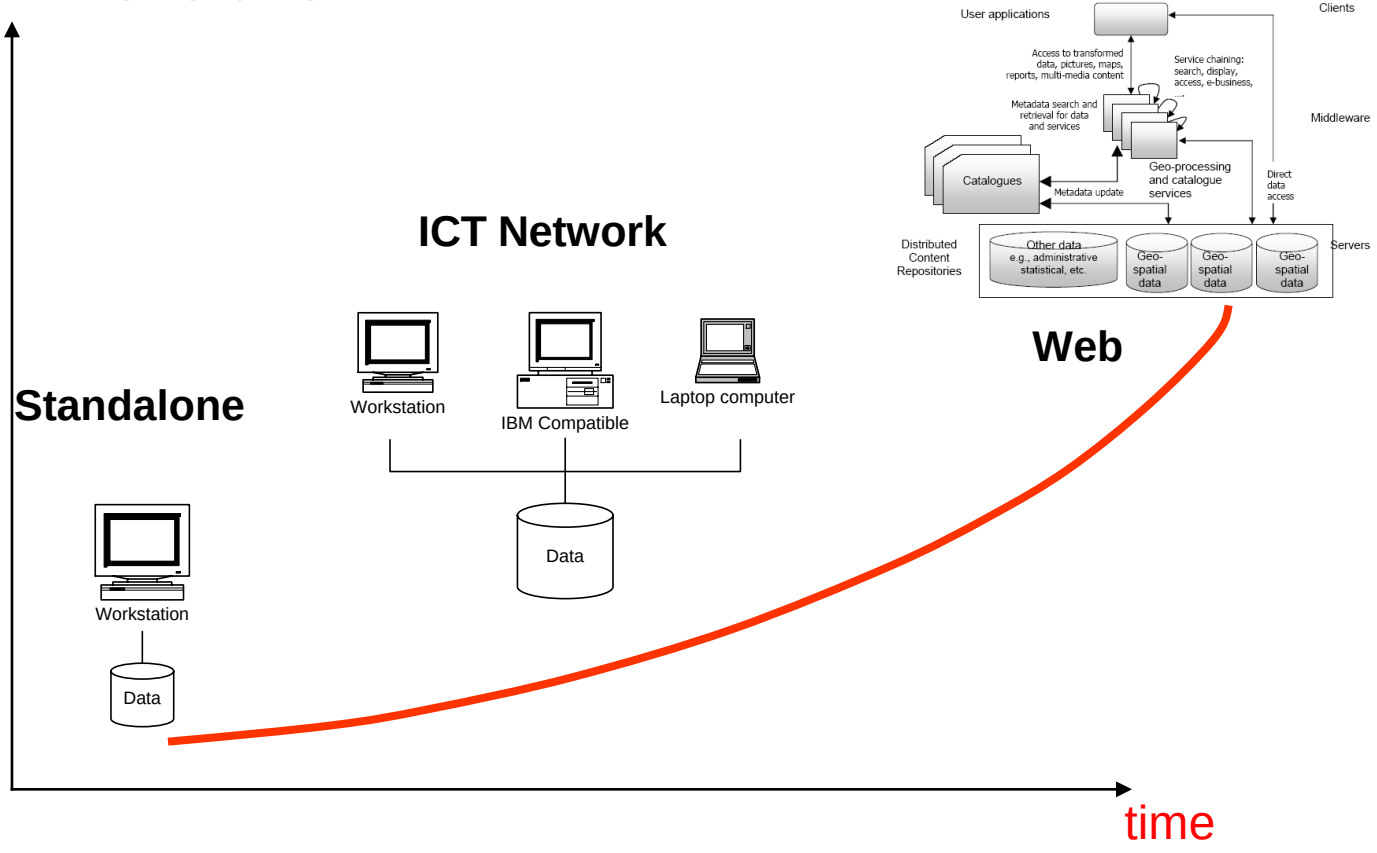
# Introduction Web Services

- Definition of web service (3WC):
  "a software system designed to support (interoperable) machine-to-machine interaction over a network."
- They allow us to create client/server applications.
- Websites are for humans, Web Services for software
- No GUI (Graphical User Interface) – only usable within applications.
- Web Services are based on XML technologies.

# Introduction Web Services

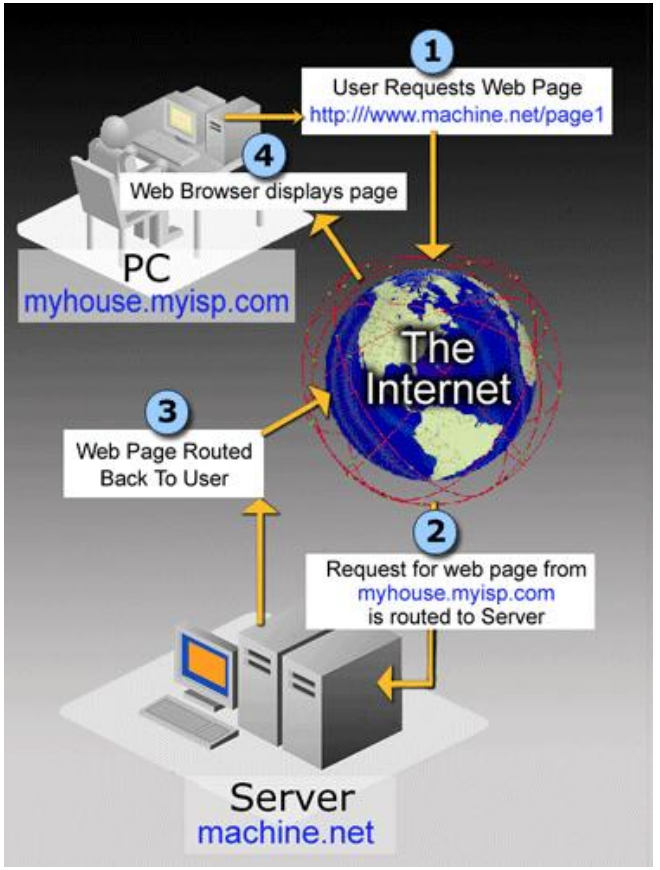
- Platform-evolution

stakeholders



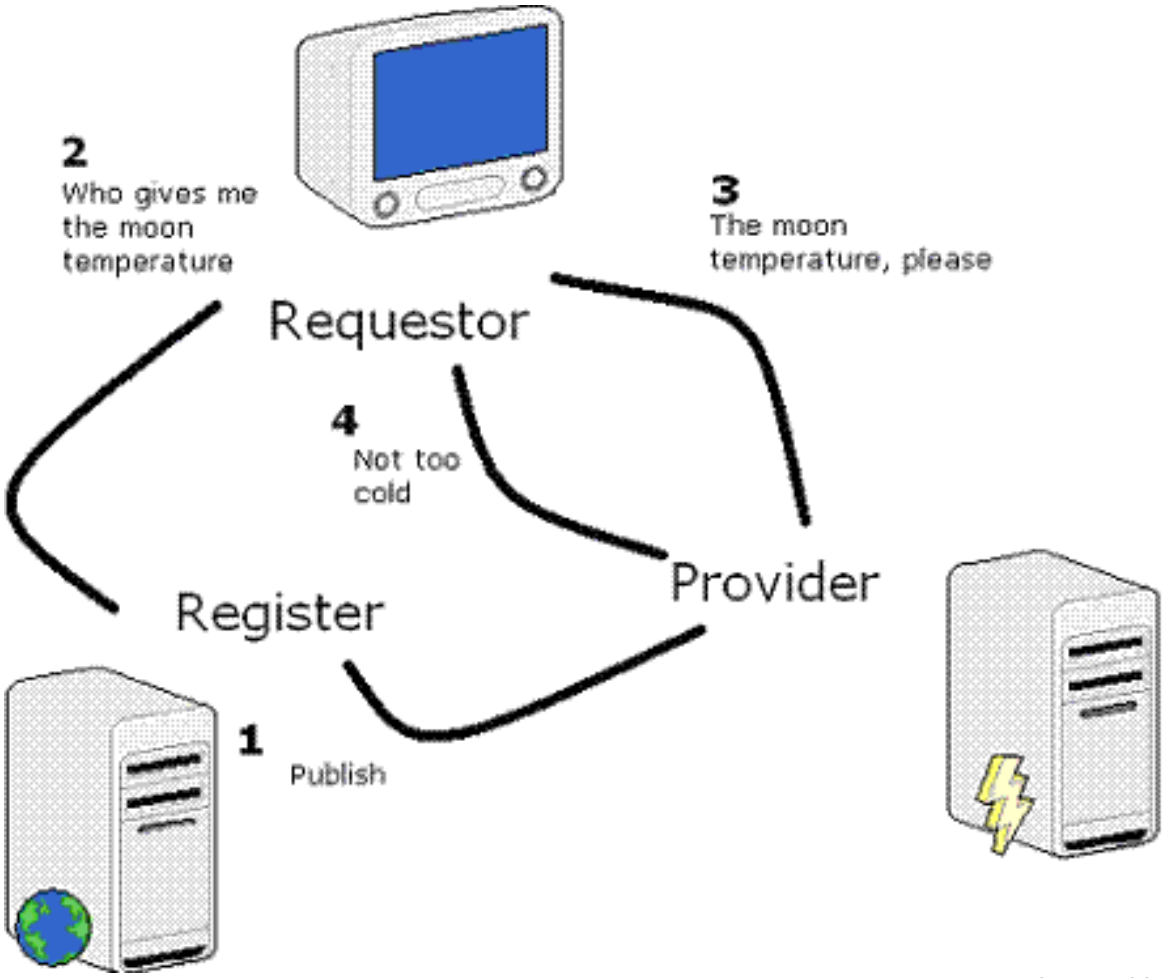
# Client-server model example: a web server

- A web server is a program that serves content (web pages, images, files, data, etc.) using HTTP (Hypertext Transfer Protocol).
- http://example.com/some/path/page.html
- Popular web servers used today: **Apache HTTP Server** and **Internet Information Services (IIS)**.




Client-server model

# Web Service Model 1

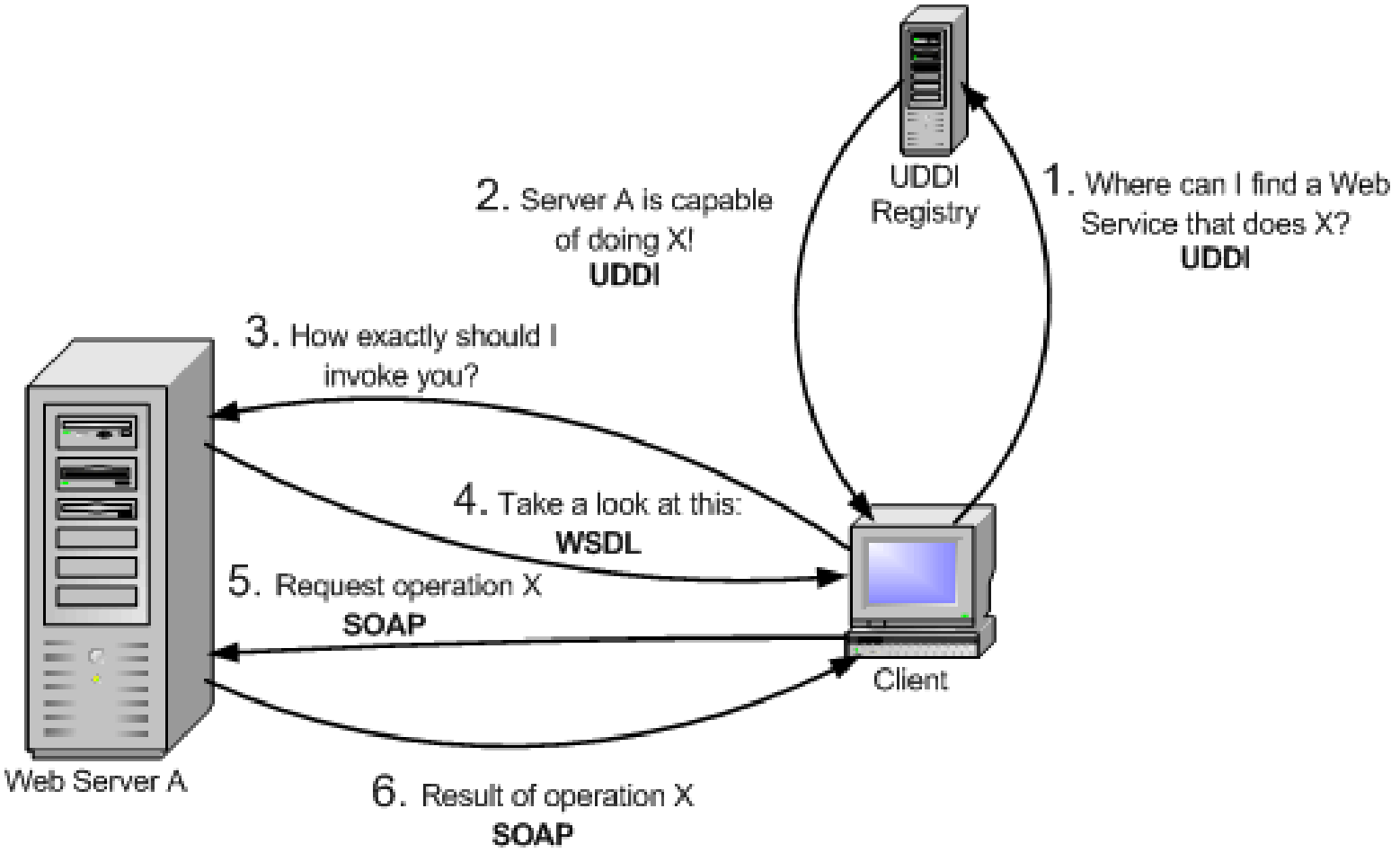



Arts-humanities.net

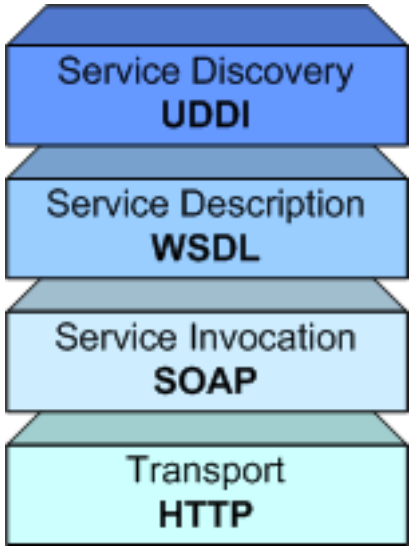
# Introduction Web Services

- Web services **advantages**:
  - Provide **interoperability** between various software applications running on different platforms
  - Platform/programming language **independent**
  - Accessible via each network supporting **open** standards and protocols
  - Allow software and services from different companies and locations to be combined easily to provide an **integrated service**
  - Web Services is that they are **self-describing**
- Web Services main **disadvantage**:
  - Overhead: transmitting data in XML is not as efficient as using binary code. What you win in portability, you lose in efficiency.

# Web Service Model 2



# Web Services Architecture

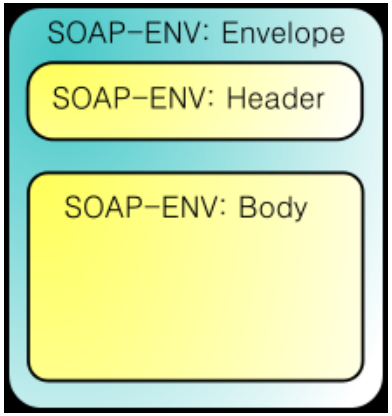



Globus.org

- Service Discovery: allows us to find Web Services which meet certain requirements. UDDI = Universal Description, Discovery, and Integration.
- Service Description : once you've located a Web Service, you can ask it to 'describe itself' and tell you what operations it supports. WSDL = Web Services Description Language.
- Invoking/using a Web Service involves passing messages between the client and the server. SOAP = Simple Object Access Protocol.
- Transport by HTTP (HyperText Transfer Protocol), the same used to access conventional web pages on the Internet.

# Sample SOAP message
## (Simple Object Access Protocol)

```
POST /InStock HTTP/1.1
Host: www.example.org
Content-Type: application/soap+xml; charset=utf-8
Content-Length: nnn
<?xml version="1.0"?>
<soap:Envelope
   xmlns:soap="http://www.w3.org/2003/05/soap-envelope">
   <soap:Header></soap:Header>
   <soap:Body>
        <m:GetStockPrice xmlns:m="http://www.example.org/stock">
               <m:StockName>IBM</m:StockName>
        </m:GetStockPrice>
   </soap:Body>
</soap:Envelope>
```




Wikipedia

# Web Services Addressing

- Q: the UDDI registry 'told' the client *where* the Web Service is located. But...how exactly are Web Services addressed?
- A: Just like web pages, but with URI’s (Uniform Resource Identifiers)
- Example: http://webservices.mysite.com/weather/us/WeatherService
- (URI and URL are practically the same thing.)

# Web Standard
# XML: eXtensible Markup Language

- World Wide Web Consortium(W3C) recommendation
- Designed to **describe data** in textual format
- **Define your own tags** (no predefined tags like HTML)
- XML uses a **Document Type Definition** (DTD) or an **XML Schema** to describe the data *(self-descriptive)*
- XML does not DO anything!
- XML *(describe data)* is NOT HTML *(present data)*
- Filename extension: .xml

# XML Example

```
<?xml version="1.0" encoding="UTF-8" ?>
<painting>
  <img src="madonna.jpg" alt="Madonna" />
  <caption>This is Raphael's Foligno Madonna
     <date>1511</date>
     <date>1512</date>
  </caption>
</painting>
```

# Outline

- Technological trends
- Introduction to Web Services
- Open Standards
- OGC Standards
  - Web Map Services (WMS)
  - Web Feature Services (WFS)
  - Catalogue Service for the web (CSW)
  - Web Processing Service (WPS)
  - Sensor Observation Service (SOS)
  - Geographic Markup Language (GML)
  - Styled Layer Descriptor (SLD)
- Open Source & ESRI GIS clients & servers

# Principles of Open Standards

Bruce Perens *(http://perens.com/OpenStandards/Definition.html)*

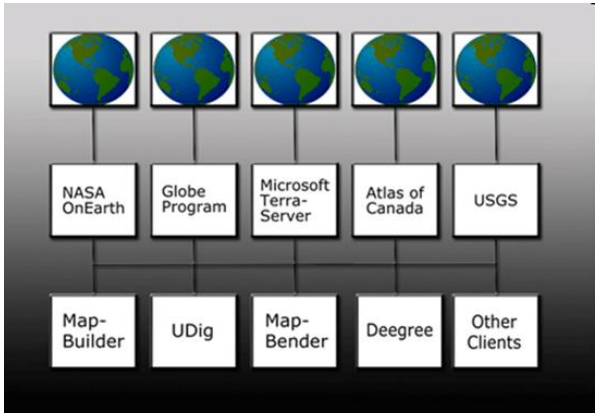
- Availability
  - Open Standards are available for all to read and implement.
- Maximize End-User Choice
  - Open Standards create a fair, competitive market for implementations of the standard. They do not lock the customer in to a particular vendor or group.
- No Royalty
  - Open Standards are free for all to implement, with no royalty or fee. Certification of compliance by the standards organization may involve a fee.

# FOSS – Free and Open Source Software

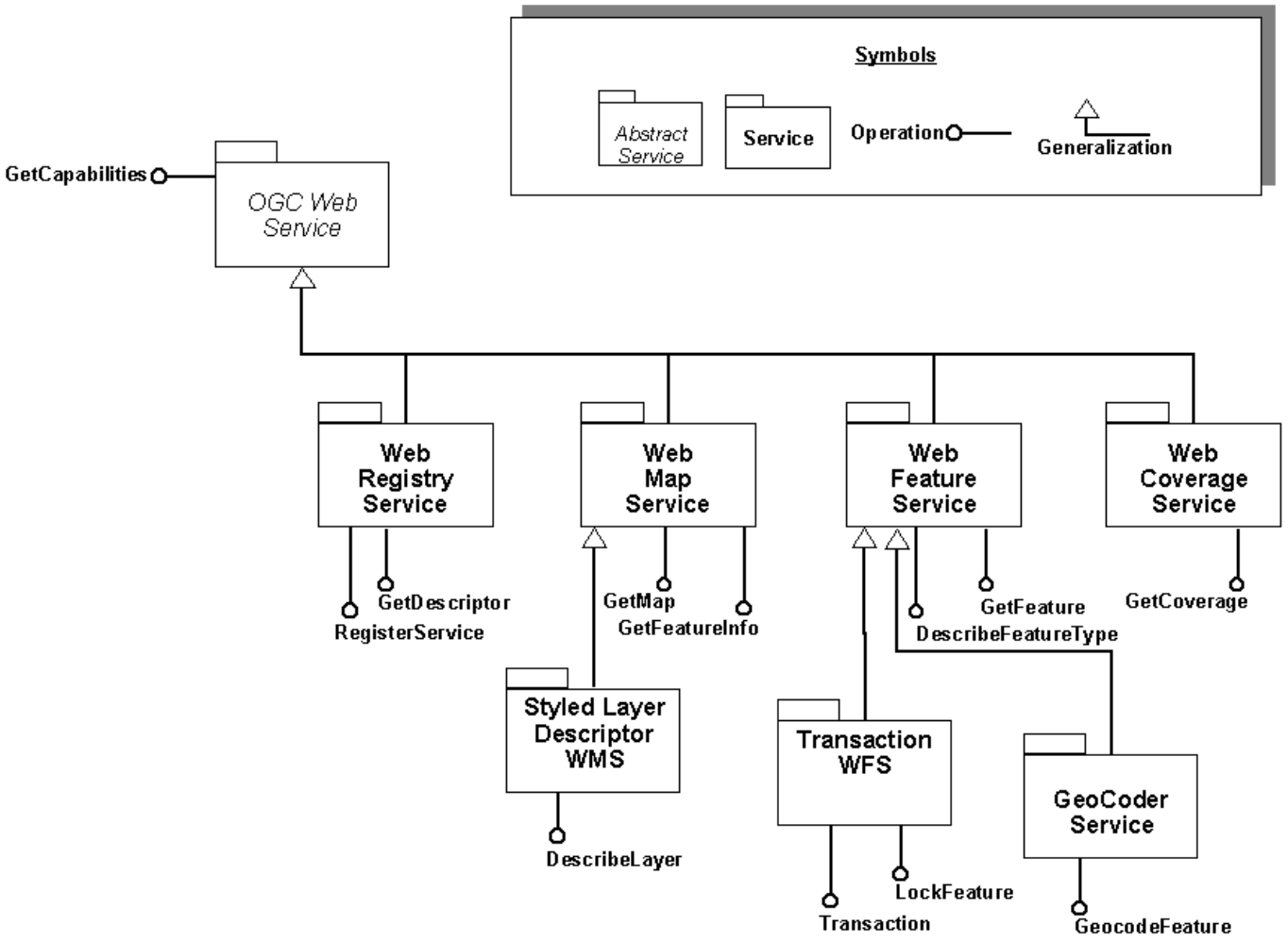
- Free and Open Source software (FOSS)
  - means that you have the right to download and look at the source code
  - For most people open source software just means that it is free.
  - has nothing to do with GIS!
- Everyday examples
  - Mozilla FireFox, Linux, ...

# OGC Standards
# Open Geospatial Consortium

- Founded in 1994
- Solve the issue of spatial data sharing and interoperability
- Sets the standards that allow geographic systems to interoperate



# OGC Network services architecture (WMS/WFS/WCS)



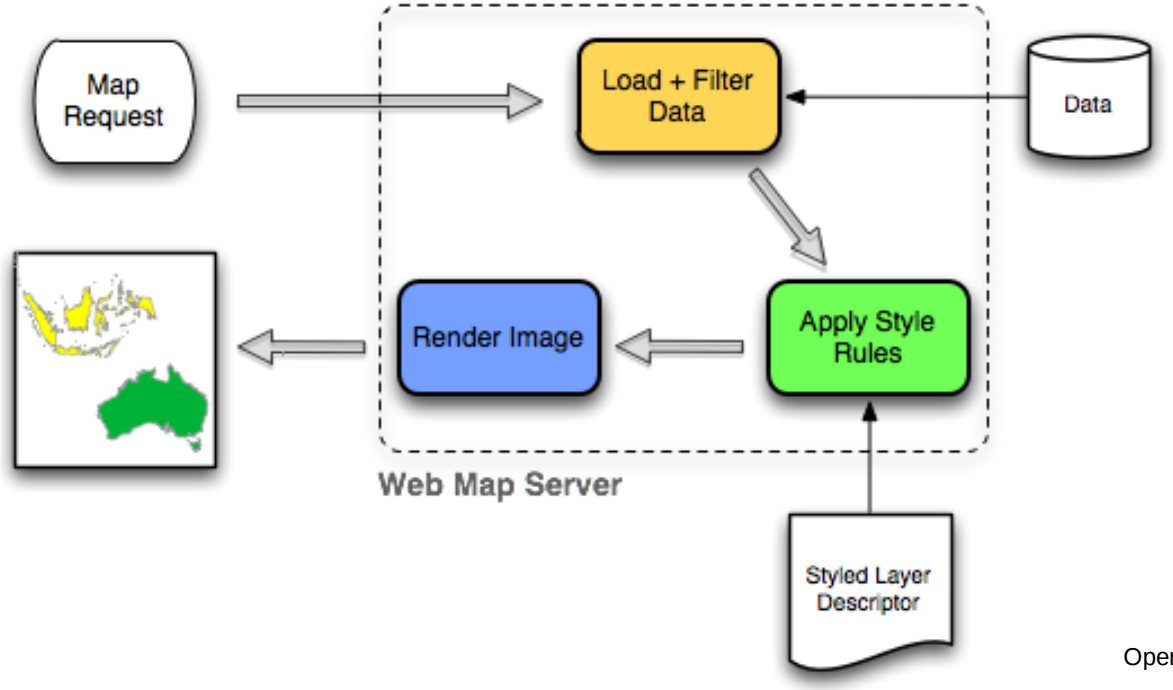
# Outline

- Technological trends
- Introduction to Web Services
- Open Standards
- OGC Standards
  - Web Map Services (WMS)
  - Web Feature Services (WFS)
  - Catalogue Service for the web (CSW)
  - Web Processing Service (WPS)
  - Sensor Observation Service (SOS)
  - Geographic Markup Language (GML)
  - Styled Layer Descriptor (SLD)
- Open Source & ESRI GIS clients & servers

# WMS – Web Map Service

- As its name implies, is a service that provides maps.
- Data only leaves the server as an image
- Map is rendered on the server so styling and presentation are how the data provider chooses.
- Limited client interactivity with the map.

# Web Map Service (WMS)




Note: source material from which the image is generated need not be an image

Can be a Shapefile, PostGIS database, Oracle Spatial,…

# Introduction to WMS

- WMS Server can do one of 3 things:
  - Produce a map (as a picture)
    - getMap
  - Answer basic queries about the content of the map
    - getFeatureInfo (returns an XML with attributes)
  - tell other programs what maps it can produce and which of those can be queried further
    - getCapabilities (returns an XML file with the metadata)

# The GetCapabilities Request

- Examples
  - http://demo.opengeo.org/geoserver/wms?SERVICE=WMS&VERSION=1.3.0&REQUEST=GetCapabilities
  - http://eusoils.jrc.ec.europa.eu:80/wmsconnector/com.esri.wms.Esrimap/Eusoils_WMS?request=getcapabilities&service=wms&version=1.1.1
- Response is XML file

# The GetMap Request Example

```
http://demo.opengeo.org/geoserver/wms?SERVICE=
  WMS&VERSION=1.1.0&REQUEST=GetMap&LAYERS=topp
  :states&SRS=EPSG:4326&BBOX=-124.731,24.956,-
  66.97,49.372&FORMAT=image/png&STYLES=&WIDTH=
  600&HEIGHT=255
```

http://demo.opengeo.org/geoserver/wms? This is the 'root' URL of the service.

SERVICE=WMS WMS service wanted

VERSION=1.1.1 This is the version of WMS service.

&REQUEST=GetMap We are requesting an map image.

&LAYERS=topp:states What layers from the service we want--can request multiple layers.

&SRS=EPSG:4326 The projection we are requesting using the EPSG code.

&BBOX==-124.731,24.956,-66.97,49.372 Bounding box coordinates in MinX, MinY, MaxX, MaxY format.

&WIDTH=600 Width of image we want.

&HEIGHT=255 Height of image we want.

&FORMAT=image/pgn Image type (jpeg, gif also possible)

&STYLES= Some services offer multiple styling options for layers.

&TRANSPARENT=FALSE Will image be transparent in areas of no data (gif and png only).

# The GetMap Response

- Image


- Error

```
<ServiceExceptionReport version="1.1.1">
    <ServiceException code="">
        WIDTH and HEIGHT incorrectly specified
    </ServiceException>
</ServiceExceptionReport>
```

# The GetFeatureInfo Request

- Example:
  http://demo.opengeo.org/geoserver/wms?SERVICE=WMS&REQUEST=**getfeatureinfo**&LAYERS=topp:states&BBOX=-124.731,24.956,-66.97,49.372&FORMAT=image/png&WIDTH=600&HEIGHT=255**&X=100&Y=100**&query_layers=topp:states

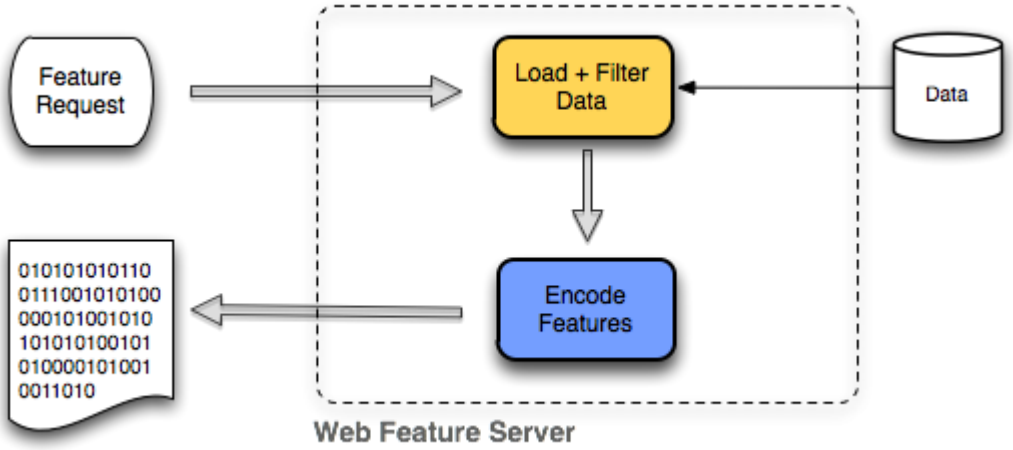
- Respons:

```
<?xml version="1.0" encoding="UTF-8"?>
<FeatureInfoResponse>
      <FIELDS FEMALES="226581" MALES="227007" POP1999="482025"
      STATE_NAME="Wyoming" _ID_="6" _SHAPE_="[Geometry]"
      _LAYERID_="0"/>
</FeatureInfoResponse>
```

| FEMALES | MALES | POP1999 | STATE_NAME | _ID_ | _SHAPE_ | _LAYERID_ |
|---|---|---|---|---|---|---|
| 226581 | 227007 | 482025 | Wyoming | 6 | [Geometry] | 0 |

# WFS – Web Feature Service

- Provides map data (GML) to a (web) client
- The client chooses style & presentational details.
- Geospatial features
- Transactional WFS-T allows the user to add and modify data on the server.



# WFS – Web Feature Service Example

http://demo.opengeo.org/geoserver/wfs?SERVICE=wfs&VERSION=1.1.0&REQUEST=GetFeature&TYPENAME=topp:states&FEATUREID=states.39

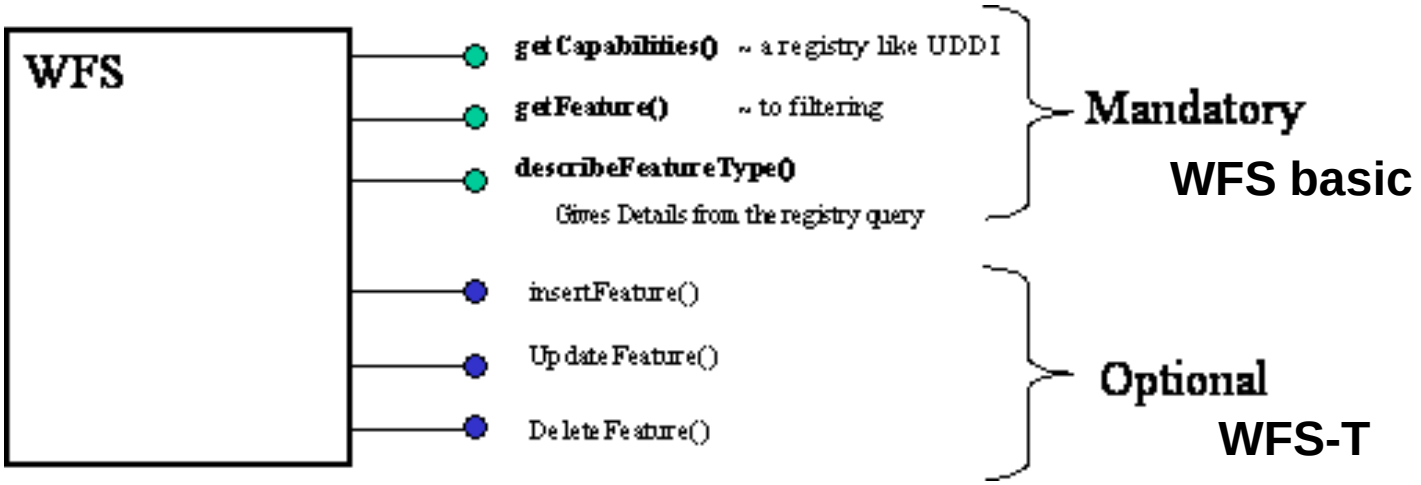

```
- <wfs:FeatureCollection numberOfFeatures="1" timeStamp="2010-06-29T16:34:42.179-04:00" xsi:schemaLocation="http://www.openplans.org/topp
  http://demo.opengeo.org/geoserver/wfs?service=WFS&version=1.1.0&request=DescribeFeatureType&typeName=topp%3Astates http://www.opengis.net/wfs
  http://demo.opengeo.org/geoserver/schemas/wfs/1.1.0/wfs.xsd">
  - <gml:boundedBy>
    - <gml:Envelope srsName="urn:x-ogc:def:crs:EPSG:4326">
        <gml:lowerCorner>40.505898 -79.763466</gml:lowerCorner>
        <gml:upperCorner>45.0061 -71.870476</gml:upperCorner>
      </gml:Envelope>
    </gml:boundedBy>
  - <gml:featureMembers>
    - <topp:states gml:id="states.39">
      - <gml:boundedBy>
        - <gml:Envelope srsName="urn:x-ogc:def:crs:EPSG:4326">
            <gml:lowerCorner>40.505898 -79.763466</gml:lowerCorner>
            <gml:upperCorner>45.0061 -71.870476</gml:upperCorner>
          </gml:Envelope>
        </gml:boundedBy>
      - <topp:the_geom>
        - <gml:MultiSurface srsName="urn:x-ogc:def:crs:EPSG:4326">
          - <gml:surfaceMember>
            - <gml:Polygon>
              - <gml:exterior>
                - <gml:LinearRing>
                  - <gml:posList>
                      42.267269 -79.763466 42.41930400000001 -79.444252 42.493404 -79.355118 42.574557999999996 -79.142471
                      42.69918799999999 -79.043991 42.792686 -78.859444 42.974174000000005 -78.93679 43.022301 -78.883034
                      43.06657000000001 -78.925835 43.09054900000001 -79.061348 43.14468400000001 -79.039558 43.26816199999999
                      -79.062469 43.371937 -78.464905 43.36551299999999 -77.992271 43.335109999999986 -77.745277 43.24148600000001
                      -77.575989 43.27565000000001 -77.377602 43.27852999999999 -76.914841 43.342667000000006 -76.737152
                      43.323375999999996 -76.718796 43.414085 -76.619957 43.500652 -76.454994 43.554084999999986 -76.223114 43.633129
                      -76.184921 43.68263200000001 -76.206017 43.83506399999999 -76.240341 43.91243 -76.194069 43.93214800000001
                      -76.129417 44.013172 -76.134872 44.06554399999999 -76.201889 44.04196200000001 -76.297226 44.09830099999999
                      -76.363213 44.390209 -75.848351 44.517474999999999 -75.758972 44.810570000000001 -75.329201 44.948578 -74.968819
```

# WFS – Web Feature Server

- Get or query features
  - based on spatial and non-spatial constraints
- Create a new feature instance
  - add features to a map.
- Update a feature instance
  - allows to change attributes on selected features
- Delete a feature instance
  - remove features from a data set.

# WFS – Static interface model

- The static interface model for the OGC Web Service model appears in the figure below.




- The basic Web Feature Service supports feature query and retrieval. A Transactional Web Feature Service (called WFS-T) enables the creation, deletion, and updating of features.

# WFS Specification & examples

- **GetCapabilities**

  Allows clients to discover what services and data types the WFS supports.

  `http://demo.opengeo.org/geoserver/wfs?SERVICE=wfs&REQUEST=GetCapabilities`

- **DescribeFeatureType**

  Allows a client to determine the schema of a feature

  `http://demo.opengeo.org/geoserver/wfs?SERVICE=wfs&REQUEST=DescribeFeatureType&TYPENAME=topp:states`

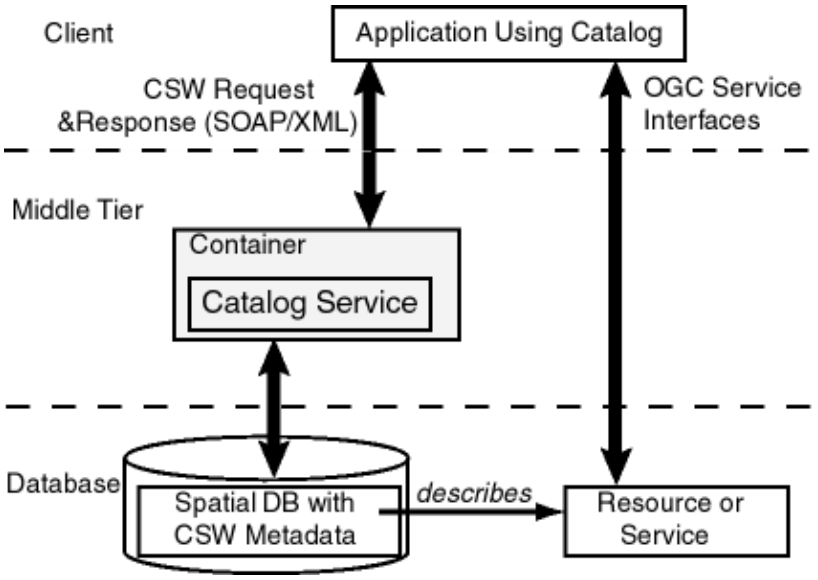
- **GetFeature**

  Returns the actual data that the client has requested *(query defines both spatial and non spatial filters to limit the number of features returned)*

  `http://demo.opengeo.org/geoserver/wfs?SERVICE=wfs&REQUEST=GetFeature&TYPENAME=topp:states&FEATUREID=states.39`

# CSW – Catalogue Servers

- A Catalogue server publishes collections of descriptive information (metadata) about geospatial data.
- Defines common interfaces to discover, browse, and query metadata.
- Providers of resources use catalogues to register metadata that conform to the provider's choice of an information model.
- Example:
  Ruimtemonitor Flanders



# CWS - Core queryables

- CSW gives flexibility in returned information
- Catalog in its basic form is simple
- Core queryables = the 15 "classic" Dublin Core metadata terms

| OGC queryable term | Dublin Core element | XML element name |
|---|---|---|
| Title | title | dc:title |
| | creator | dc:creator |
| Subject | subject | dc:subject |
| Abstract | description | dc:description |
| | publisher | dc:publisher |
| | contributor | dc:contributor |
| Modified | date | dc:modified |
| Type | type | dc:type |
| Format | format | dc:format |
| Identifier | identifier | dc:identifier |
| Source | source | dc:source |
| | language | dc:language |
| Association | relation | dc:relation |
| BoundingBox | coverage | ows:BoundingBox |
| | rights | dc:rights |

# The CSW specification

CSW supports 5 operations:

- getCapabilities
  - allows clients to discover metadata about the service indicating its data holdings and abilities. Example: http://appsrv.sadl.kuleuven.be:8080/geonetwork/srv/en/csw?service=CSW&request=GetCapabilities
- describeRecord
  - allows a client to discover elements of the information model supported by the target catalogue service. The operation allows some or all of the information model to be described.
- getRecords
  - GetRecords operation works as the primary mean of resource discovery in the HTTP protocal binding (it does a search).
- getRecordById
  - request retrieves the default representation of catalogue records using their identifier.It returns the detailed information for some specific objects of interest.
- Transaction: Insert, Update & Delete of metadata

# The GetRecords Response

Aggregate Results matching search criteria : 1-10 / 80 (pagina 1/8)

**KORRELMAAT PERCELEN (ROOSTER 1KMX1KM)**

Abstract Deze indicator geeft de korrelmaat van de percelen weer: dit is de gemiddelde grootte (oppervlakte) van de percelen per rooster (1kmx1km). Opbouw van de indicator: Voor deze indicator wordt...

Keywords Korrelmaat, percelen, Vlaanderen

⊞ Metadata | Map / Report

**TIJDREEKS EVOLUTIE VAN SERRETEELTEN**

Abstract Deze tijdreeks (1990 - 2005) toont de absolute evolutie in oppervlakte serreteelten per gemeente. De evolutie van serreteelten geeft een beeld over de verschuiving van concentratiegebieden...

Keywords serre, serreteelt, concentratie, evolutie, landbouw, tuinbouw, gemeente, open ruimte, Vlaanderen

⊞ Metadata | Map / Report

**SCHAALVERGROTING IN DE LAND-EN TUINBOUW**

Abstract Schaalvergroting van land- en tuinbouwbedrijven is een ontwikkeling die zich verspreid over Vlaanderen voordoet en in de verschillende productierichtingen. Per gemeente wordt de absoluut sc...

Keywords schaalvergroting, landbouw, tuinbouw, gemeente, open ruimte, Vlaanderen

⊞ Metadata | Map / Report

**BEDRIJFSCONTINUÏTEIT OP BASIS VAN OPVOLGINGS- EN VERGRIJZINGSGRAAD**

Abstract Het fenomeen van vergrijzing en lage opvolgingsperspectieven is belangrijk om in rekening te brengen voor het bepalen van een toekomstvisie van de land- en tuinbouw voor de regio's met lage ...

Keywords Bedrijfscontinuïteit, opvolgingsperspectieven, vergrijzing, Vlaanderen

⊞ Metadata | Map / Report

**DICHTHEID VERSPREIDE BEBOUWING PER OPPERVLAKTE (NIS-METHODE OP STATISTISCHE SECTOR)**

Abstract Deze indicator geeft de dichtheid van verspreide bebouwing weer per statistische sector, met uitsluiting van stedelijke gebieden en NIS-woonkernen. In eerste instantie wordt vertrokken vanu...

Keywords verspreide bebouwing, NIS, Vlaanderen

⊞ Metadata | Map / Report

**DICHTHEID BEBOUWINGSKORRELS PER OPPERVLAKTE (RSV-METHODE OP ROOSTERCEL)**

Abstract Deze indicator geeft de dichtheid aan verspreide bebouwing weer per roostercel, met uitsluiting van stedelijke gebieden en RSV-woonkernen. Opbouw van de indicator: In eerste instantie word...

Keywords bebouwingskorrels, RSV, Vlaanderen

⊞ Metadata | Map / Report

# The DescribeRecord Request

## Identification info

| | |
|---|---|
| Title | Korrelmaat percelen (rooster 1kmx1km) |
| Date | 2009-06-23T15:43:00 |
| Date Type | Publication |
| Abstract | Deze indicator geeft de korrelmaat van de percelen weer: dit is de gemiddelde grootte (oppervlakte) van de percelen per rooster (1kmx1km). Opbouw van de indicator: Voor deze indicator wordt een intersectie uitgevoerd van de datalaag Kadvec_percelen_polygonen en de datalaag van de RE (bewerking: intersect). Daarna worden alle objecten per RE samengevoegd (bewerking: sumarize). Bij deze bewerking wordt het minimum, maximum, totaalsom, standaardafwijking en gemiddelde berekend. Een derde bewerking bestaat erin deze gegevens te koppelen aan de oorspronkelijke RE (bewerking: join). Zo krijgen we nieuwe informatie per RE. Om het kaartbeeld te bekomen wordt de gemiddelde oppervlakte van de RE weergegeven. De bekomen waarden worden in vijf categorieën opgedeeld, de eenheid van de indicator is de gemiddelde oppervlakte van de percelen (m2). |

### Point of contact

| | |
|---|---|
| Individual Name | Thomas Verbeek; Ann Pisman |
| Organisation Name | UGent |
| Position Name | |
| Delivery Point | |
| City | Gent |
| Administrative Area | |
| Postal Code | 9000 |
| Country | België |
| Electronic Mail Address | thomas.verbeek@ugent.be |
| Role | originator |

| | |
|---|---|
| Maintenance And Update Frequency | |
| Descriptive Keywords | Korrelmaat, percelen (theme). |
| Descriptive Keywords | Vlaanderen (place). |
| Access Constraints | copyright |
| Use Constraints | |
| Other Constraints | Geef hier beperkingen op (andere dan toegang en gebruik) |
| Spatial Representation Type | vector |

### Equivalent scale

| | |
|---|---|
| Denominator | rooster (1kmx1km) |

| | |
|---|---|
| Language | Dutch; Flemish |
| Character Set | utf8 |

### Extent

#### Extent

##### Geographic bounding box

**North bound latitude**
51.506287

**West bound longitude**
2.528574

**East bound longitude**
5.935122

**South bound latitude**
50.674615

| | |
|---|---|
| Supplemental Information | De basisvariabele is de ruimtelijke verdeling van de percelen in Vlaanderen. Mercatordatabank, Kadvec_percelen_polygonen Mercatordatabank Technisch_rooster_1x1 Mercatordatabank Grenzen_Statistische sectoren2006 Mercatordatabank Grenzen_fusiegemeenten2006 |

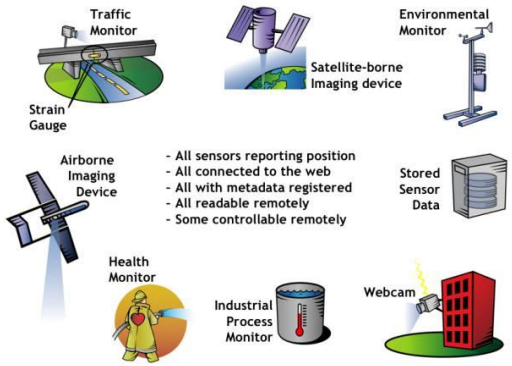
### Distribution info

# Web Processing Service

- Web Processing Service (WPS)
  - One of OGC's most recent interoperability standards
  - Request the execution of a spatial (GIS) calculation (Buffer, Clip,…), returns image / gml
- WPS defines three operations:
  - **GetCapabilities** returns service-level metadata
  - **DescribeProcess** returns a description of a process including its inputs and outputs
  - **Execute** returns the output(s) of a process:
    the request identifies the inputs, the name of process to be executed, and the form of output to be provided.
- Demo video: http://www.youtube.com/watch?v=bb0JqmZW7S4

# Sensor Observation Service (SOS)

- Retrieval of real time or archived data produced by all kinds of sensors
- Managing deployed sensors




- Operations:
  - GetCapabilities: a self-description of the service.
  - GetObservation: for requesting the sensor data encoded
  - DescribeSensor: information about the sensor itself
  - RegisterSensor: for signing up new sensors.

- Example: http://www.openioos.org/real_time_data/gm_sos.html

# Geographic Markup Language (GML)

- Standard way for data to be passed from one geographic application to another.
- Is the XML grammar defined by the Open Geospatial Consortium (OGC) to express geographical features.
- Response of WFS requests is GML
- Filename extension: .gml

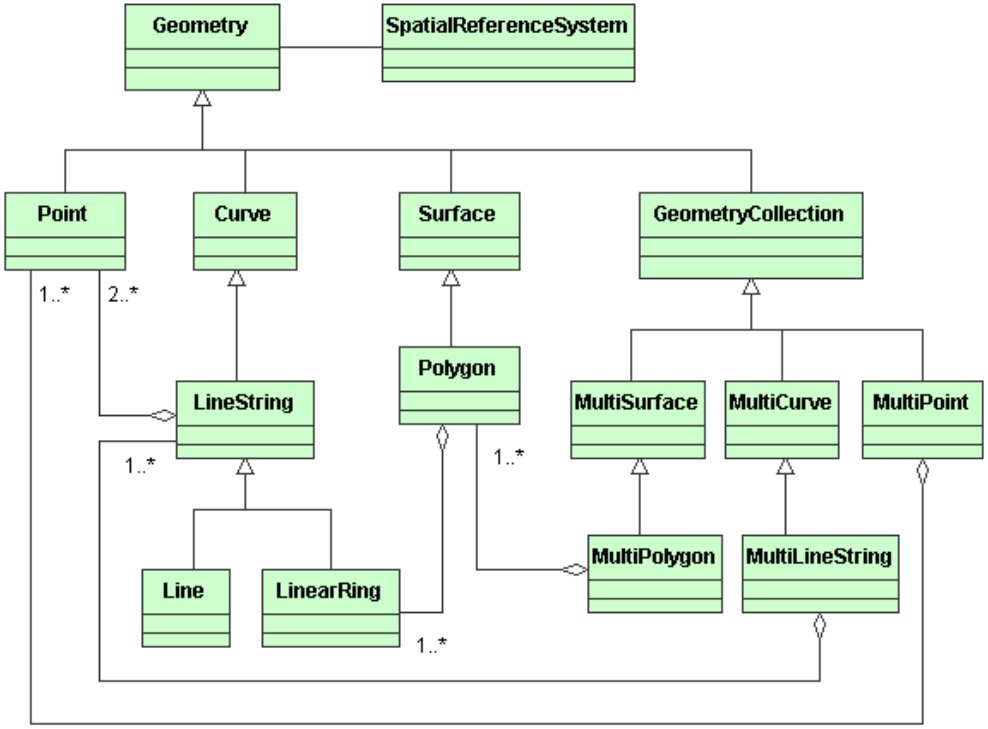
```
<gml:MultiLineString srsName="http://www.opengis.net/gml/srs/
  epsg.xml#27354">
  <gml:lineStringMember>
      <gml:LineString>
          <gml:coordinates decimal="." cs="," ts=" ">
494475.71056415,5433016.8189323
              494982.70115662,5 435041.95096618 </gml:coordinates>
          </gml:LineString>
      </gml:lineStringMember>
  </gml:MultiLineString>
```

# GML

- Scope of GML
  - A modelling language for geographic information
  - An encoding for geographic information
  - Designed for the web and web-based services
- GML is
  - An open standard
  - Enabling a vendor neutral exchange of spatial data
  - Ready for Service oriented architectures.
- .

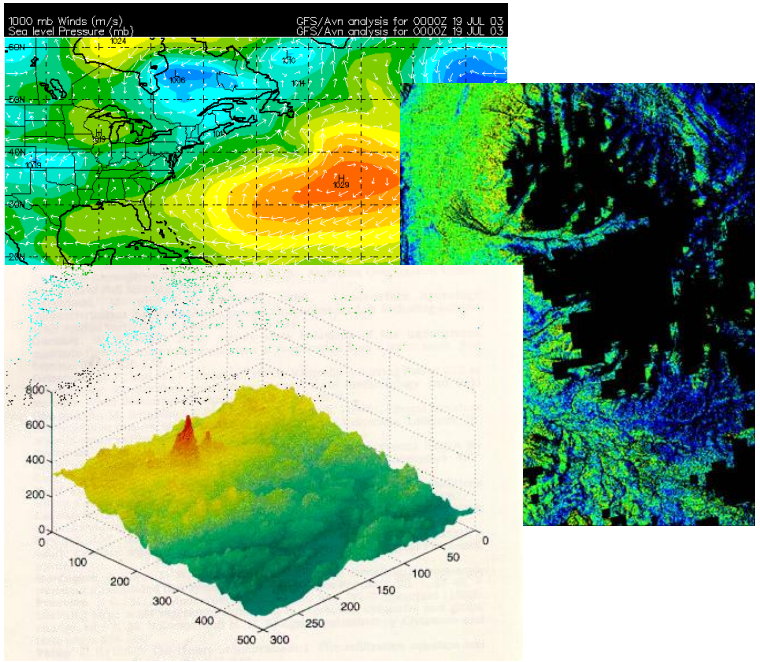
# Geometries

- GML 2
  - **Point:** a single point in geographic space (+ Z)
  - **Polygon:** a closed area of geographic space (+ Z)
  - **LineString:** a linear geographic feature (+ Z); the line is represented as a series of points joined by lines



# Geometries

- GML 3
  - **Curve:** LineStrings, Arc, CubicSpline, Bezier
  - **Surface:** Polygons, Patches, Rectangles, Triangles
  - **Coverages (grids):** rasters



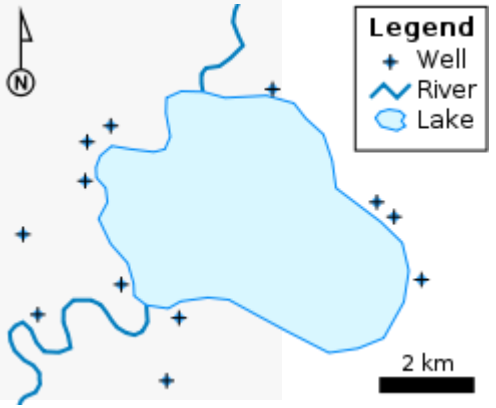
# Examples of simple GML - Geometries:

```
<gml:Point>
   <gml:coordinates>100,200</gml:coordinates>
</gml:Point>


<gml:Polygon>
    <gml:outerBoundaryIs>
            <gml:LinearRing>
                    <gml:coordinates>0,0 100,0 100,100 0,100 0,0</gml:coordinates>
            </gml:LinearRing>
   </gml:outerBoundaryIs>
</gml:Polygon>


<gml:LineString>
   <gml:coordinates>100,200 150,300</gml:coordinates>
</gml:LineString>


 <!-- Feature: -->
 <abc:Building gml:id="SearsTower">
      <gml:name>Sears Tower</gml:name>
      <abc:height>52</abc:height>
      <abc:position>
          <gml:Point>
              <gml:coordinates>100,200</gml:coordinates>
          </gml:Point>
      </abc:position>
 </abc:Building>
```



# Keyhole Markup Language (KML)

- Made popular by Google
- Is a specific GML:
  - GML is a language to encode geographic content for any application
  - KML is tailored for "Google Earth".
- KML zipped (compressed) = KMZ
- KML uses 3D geographic coordinates: longitude, latitude (WGS84) and altitude.

# Styled Layer Descriptor (SLD)

- Describes how a map will look like
- Instruct a Web Map Service (WMS) how to render a specific layer
- Open standard created by the Open Geospatial Consortium (OGC)
- XML-based format
- ”Styler”, a graphical style editor (works with GeoServer)

# Styled Layer Descriptor (SLD): example

Draws a simple 6-pixel red circle for each data point:

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<StyledLayerDescriptor version="1.0.0"
 xsi:schemaLocation="http://www.opengis.net/sld StyledLayerDescriptor.xsd"
 xmlns="http://www.opengis.net/sld"
 xmlns:ogc="http://www.opengis.net/ogc"
 xmlns:xlink="http://www.w3.org/1999/xlink"
 xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <NamedLayer>
    <Name>Simple Point</Name>
    <UserStyle>
      <Title>Simple Point</Title>
      <FeatureTypeStyle>
        <Rule>
          <PointSymbolizer>
            <Graphic>
              <Mark>
                <WellKnownName>circle</WellKnownName>
                <Fill>
                  <CssParameter name="fill">#FF0000</CssParameter>
                </Fill>
              </Mark>
              <Size>6</Size>
            </Graphic>
          </PointSymbolizer>
        </Rule>
      </FeatureTypeStyle>
    </UserStyle>
  </NamedLayer>
</StyledLayerDescriptor>
```

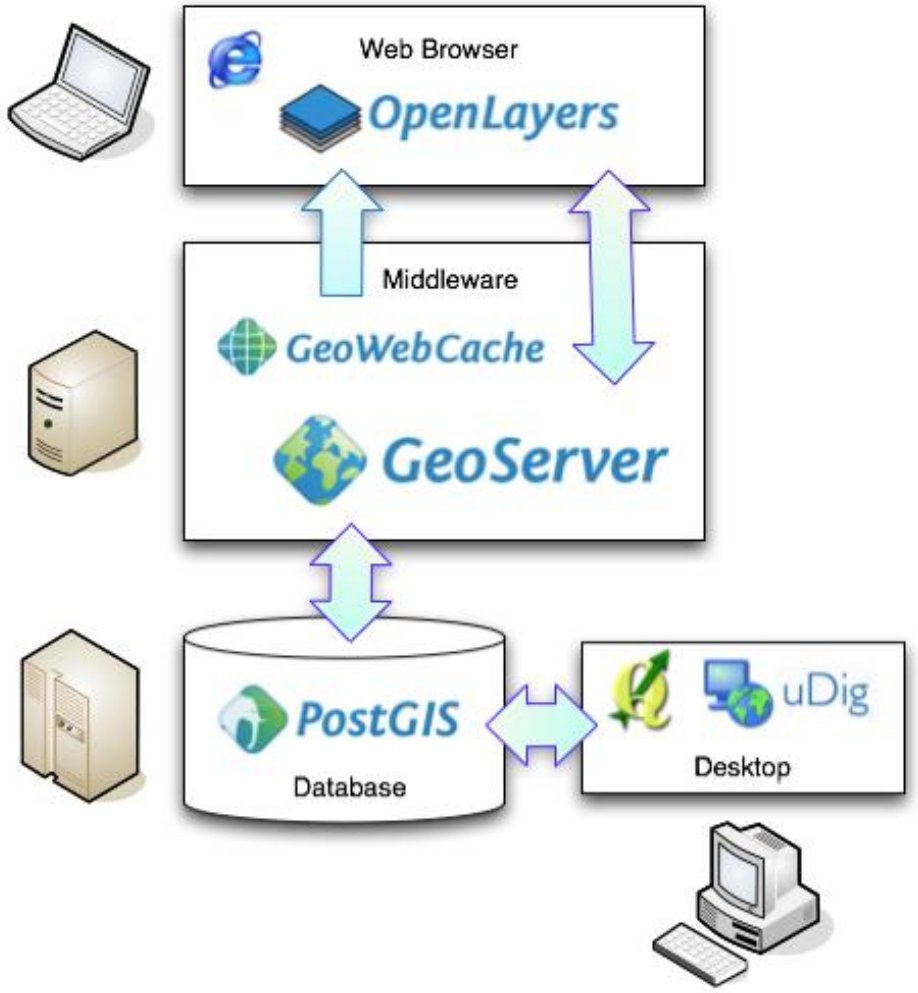
# Outline

- Technological trends
- Introduction to Web Services
- Open Standards
- OGC Standards
  - Web Map Services (WMS)
  - Web Feature Services (WFS)
  - Catalogue Service for the web (CSW)
  - Web Processing Service (WPS)
  - Sensor Observation Service (SOS)
  - Geographic Markup Language (GML)
  - Styled Layer Descriptor (SLD)
- Open Source & ESRI GIS clients & servers

# Just a few OS WMS/WFS Clients and Servers

- **Desktop clients:**
  - QGIS
  - uDIG
  - Gaia
  - GRASS
  - MapBuilder  (Browser based mapping client)
- **Servers**
  - GeoServer
  - MapServer
  - DEEGREE
  - MapGuide OpenSource

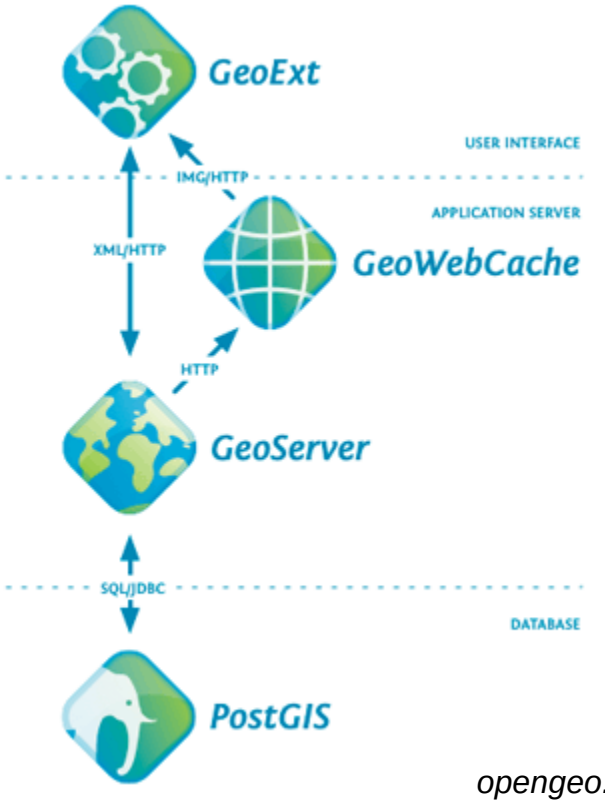
# Open Source Geostack




*opengeo.org*

# OpenGeo Suite

- Full stack of software:
  - GeoServer
  - PostGIS
  - GeoWebCache
  - OpenLayers
  - GeoExt
- Download: http://opengeo.org/community/suite/




*opengeo.org*

# ESRI ArcGIS for Server

- Software from ESRI to create GIS Web services.
- You can choose from ‘Basic’, ‘Standard’ or ‘Advanced’ editions (for example: “Web Editing” & “Geoprocessing” are not available in the basic edition). Overview: http://www.esri.com/software/arcgis/arcgisserver/key-functionality.html
- Example: http://gis.cityofboston.gov/SolarBoston/

# Interesting links

- http://www.opengeospatial.org/
- http://opengeo.org/
- http://www.osgeo.org
- http://opensourcegis.org/
- http://freegis.org
- http://www.maptools.org
- http://geotools.codehaus.org/
- http://courseware.e-education.psu.edu/courses/geog585/content/home.html
- http://ees.kuleuven.be/legio/index.html

# References

- OGC - Open Geospatial Consortium
- Osgeo.org (Open Source Geospatial Foundation)
- Opengeo.org
- Wikipedia
- Globus.org
- Arts-humanities.net
- Addons.mozilla.org

# (Thank you..) Questions?

http://www.sadl.kuleuven.be

Diederik.Tirry@sadl.kuleuven.be