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GI Standardisation

-

Who, Why, How

Or:

How to ensure interoperability

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http://www.agis.unibw-muenchen.de
Universität der Bundeswehr München

UniBw München

About 3000 Students (mostly living on campus, mostly soldiers, staff is civil, Trimester system!)

10 Faculties / Departments – 13 programs

The Faculties:

- **Civil Engineering, Geodesy and Geoinformatics (Univ)**
- **Electro and Information Technology**
- **Computer Science**
- **Aeronautics and Aerospace Technologies**
- **Education Sciences**
- **Social Sciences**
- **Economics**
- **Business Management (FH)**
- **Electrical Engineering**
- **Mechanical Engineering**

AGIS – GI lab

GI-Lab at UniBw M,

civil engineering faculty

founded: 1997 (Caspary/Reinhardt)

tasks:

- **Education, professional training**
- **Research**
- **Research transfer**

15 scientists, mostly financed from 3. Party funds

assoziiert .GIS Dr. Gerhard Joos

PhD. Rixing He,

'04

Current research projects

Interoperability / standards

- GI-Interoperability based on XML/GML
- GI Normung / Standardisation (Quality procedures)
- Concepts for meta data

Projects with utilities

- **Quality management**
  - **Q-assurance**
  - **Process optimisation**

Object oriented classification / RS

Data Visualization (SVG)

GI education

- **GI teaching modules (BMBF)**
- **GIS- Introduction / Virtuelle Hochschule Bayern (vhb)**

Mobile GI Services

- GI-based positioning of locomotives
- VISPA, Paramount (LBS for hiker / wanderer
- Advanced Geo-Services (BMBF / DFG – Geotechnologien)

Background

- Member of German standardisation body (DIN)
- Staff is member of German delegation in ISO
- OGC member
- Projects to apply and / or to test standardisation results

Overview

- Who does Standardisation in GI
- Why Standardisation in GI
- Examples (standards in practical use)
- Applications

⇨ No systematic overview on all the topics of GI standardisation!

Situation: Why standardisation?

- Many GI data bases available, but distributed in different systems, different models ..
- Searching for data is still difficult (Metadata!)
- Access to data still not „fluent“
- Usability of data can be improved
- Integration of GI data into all kinds of applications required
- ..

Disciplines using GIS

Aerospace Engineering
Agricultural Economics
Agricultural Engineering
Agronomy
Animal Science
Anthropology
Applied Physics
Archaeology
Architecture
Area Studies
Base Management
Battlefield Management
Biostatistics
Botany
Business Administration
Chemical Engineering
City Planning
Civil Engineering
Classical Studies
Climatology
Coastal Studies
Communications
Computer Science
Conservation Biology
Criminal Justice
Decision Support Systems
Demography
Earth Science
Ecology
Economics
Electrical Engineering
Entomology
Environmental Design
Environmental Engineering
Environmental Health
Environmental Science
Epidemiology
Ethnic Studies
Farm & Ranch Management
Fisheries
Forestry
Geochemistry
Geographic Information Sciences
Geography
Geology
Geomatics (Surveying)
Geosciences,
Government
Government Documents Library
Health Care Management
Historic Preservation
History
Hydrology
Industrial Engineering
International Studies
Journalism
Journalism
Jurisdictional Law
Landscape Architecture
Linguistics
Map & Imagery Library
Marine Biology
Marketing
Mechanical Engineering
Meteorology
Military Supply & Logistics
Natural Resource Management
Natural Sciences
Oceanography
Operations Research
Paleontology
Parks & Recreation
Pedology
Pest Management
Physical Sciences
Plant Science
Political Science
Psychology
Public Administration
Public Health
Public Health & Medicine
Quaternary Research
Range Management
Real Estate Law
Real Estate Management
Redistricting Law
Reference Librarian
Regional Planning
Regional Science
Religion
Retail Management
Science Education
Secondary Education
Seismology Research
Sociology
Software Engineering
Soil Science
Technical Education
Telecommunications
Transportation Engineering
Transportation Fleet Mgt.
Travel & Tourism
Urban Design
Urban Planning
Veterinary Science
Water Resources Management
Weed Science
Wildlife Management
Zoology

Who?

Standardisation bodies (and others)!

Standardisation bodies

Germany	US/International
Norm	Standard
Standard	“Defacto“-Standard

Authorised standardisation bodies:

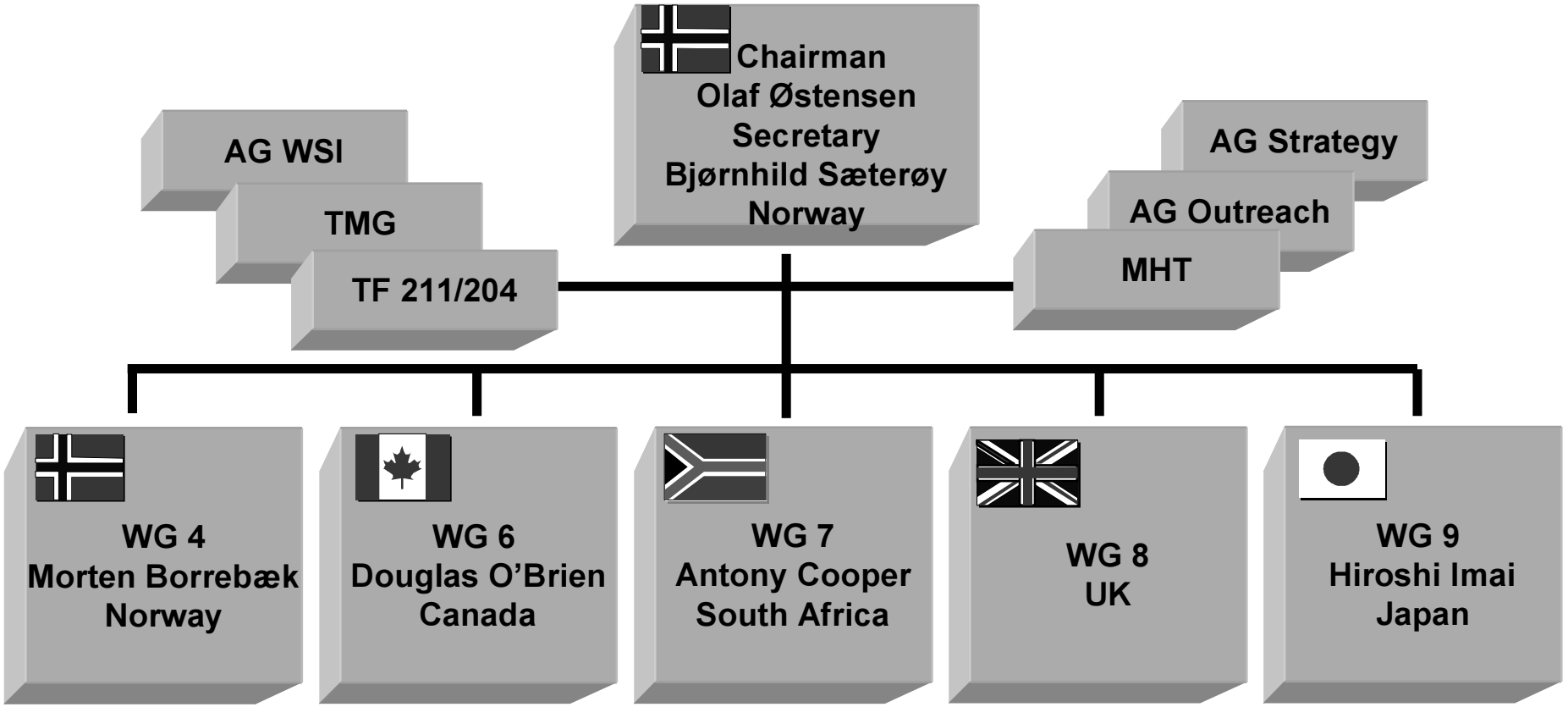
DIN • CEN • ISO

Defacto standards: OGC

Cooperation: ISO und OGC!

ISO / TC 211, Geographic information

Started: 1994!



Src: H. Knoop, 7. Seminar GIS & Internet, UniBw München, 2004

Standards for Spatial Data Infrastructures

Standards	Access, technology	Content (data)	Organization	Education

Documentation

Standards

ISO 19103 - Conceptual schema language
ISO 19107 - Spatial schema
ISO 19108 - Temporal schema
ISO 19109 - Rules for application schema
ISO 19110 - Feature cataloguing methodology
ISO 19111 - Spatial referencing by coordinates
ISO 19112 - Spatial referencing by geographic identifiers
ISO 19113 - Quality principles
ISO 19114 - Quality evaluation procedures
ISO 19115 – Metadata
ISO/TR 19121 - Imagery and gridded data
ISO 19123 - Schema for coverage geometry and functions
ISO 19124 - Imagery and gridded data components
ISO 19126 - Profile - FACC Data Dictionary
ISO 19127 - Geodetic codes and parameters
ISO 19129 - Imagery, gridded and coverage data framework
ISO 19130 - Sensor and data model for imagery and gridded data
ISO 19131 - Data product specification
ISO 19137 - Generally used profiles of the spatial schema and of similar important other schemas

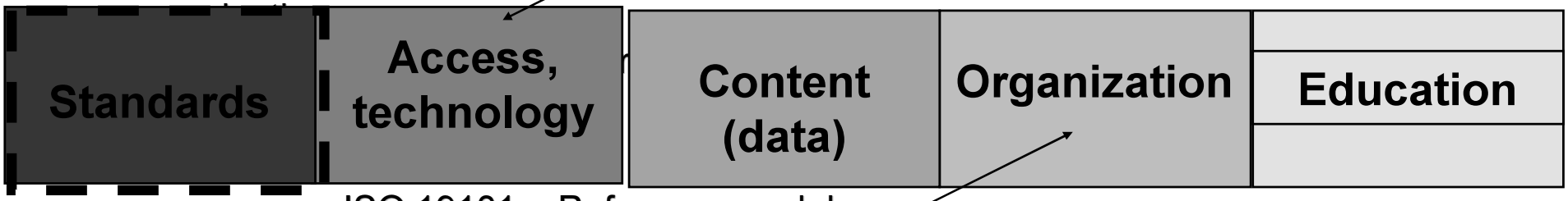
ISO/TR 19122 - Qualifications and certification of personnel

Src: H. Knoop, 7. Seminar GIS & Internet, UniBw München, 2004

Standards for Spatial Data Infrastructures

Access and services

ISO 19116 - Positioning services
ISO 19117 – Portrayal
ISO 19118 – Encoding
ISO 19119 – Services
ISO 19125-1 - Simple feature access – Common architecture
ISO 19125-2 – SFA – SQL option
ISO 19125-3 – SFA – COM/OLE
ISO 19128 - Web Map Server Interface
ISO 19132 - Location based services possible standards
ISO 19133 - Location based services tracking and navigation
ISO 19134 - Multimodal location based services for routing and

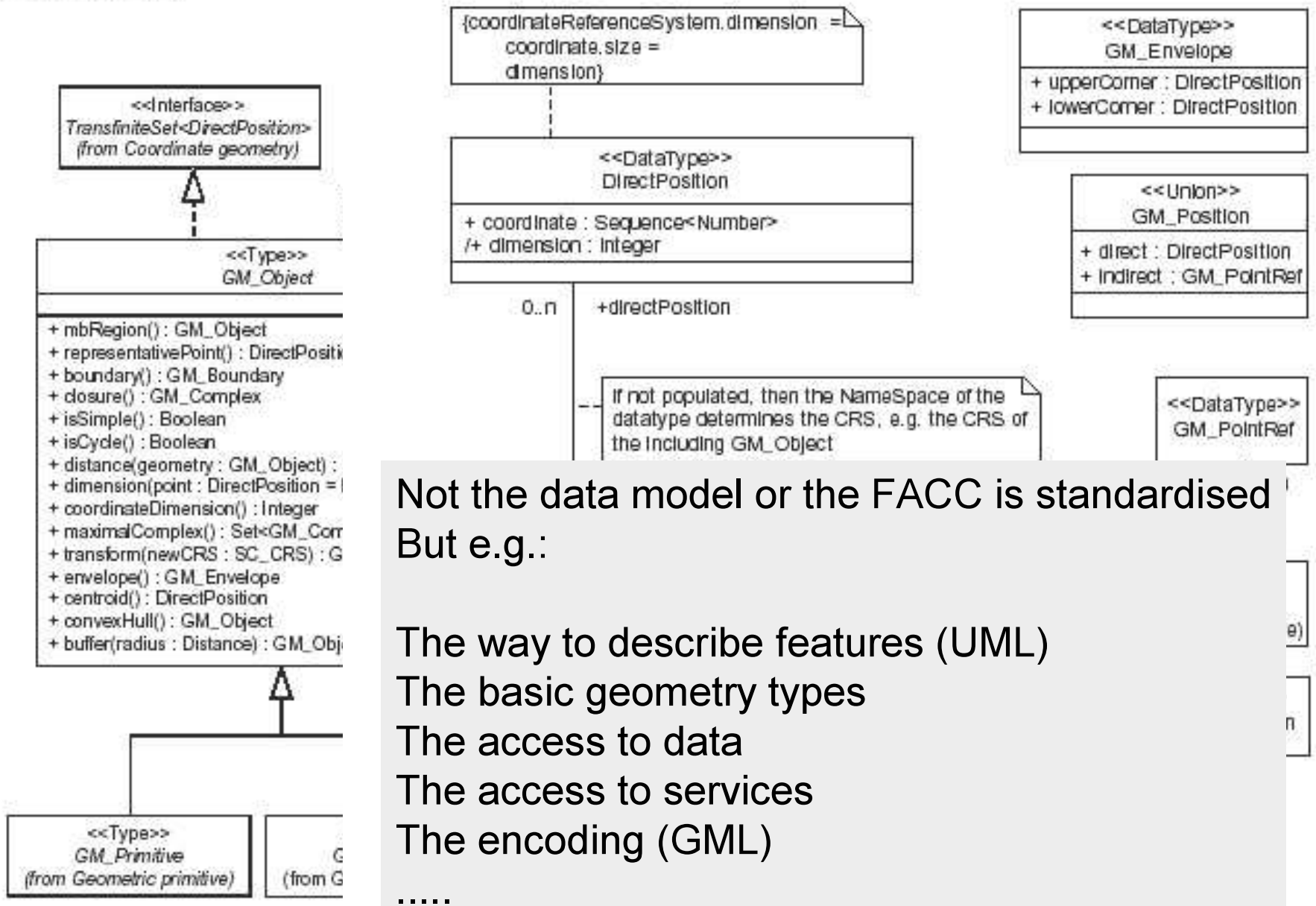


ISO 19101 – Reference model
logy
ance and testing

tional standards
res for registration of geographic information items

Remark:
Is everyting necessary?
Is everything of high quality?
Evaluation?

ISO 19107:2003(E)

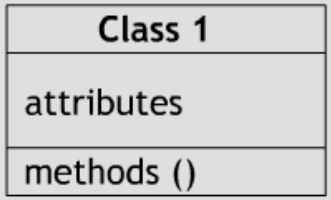


Not the data model or the FACC is standardised
But e.g.:

The way to describe features (UML)
The basic geometry types
The access to data
The access to services
The encoding (GML)
.....

Figure 6 — GM_Object

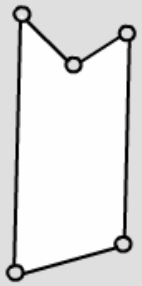
Basic principles of UML



UML to GML

Application object:

geometry:



Open Geospatial Consortium (OGC)

Founded: 1994

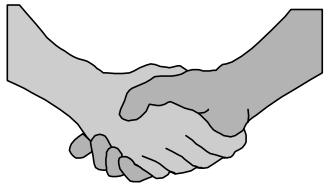
OGC Mission

"Our core mission is to deliver interface specifications that are openly available for global use"

http://www.opengeospatial.org/ - www.opengis.org (still!)

OGC is an international industry consortium of 258 companies, government agencies and universities participating in a consensus process to develop publicly available geoprocessing specifications.

ISO/TC 211 & OGC



1994

- ISO/TC 211 - de jure formal standards technical committee
- OGC - de facto industry technical specifications
- 1999 - OGC - ISO/TC 211 Class A Liaison status
- ISO/TC 211 & OGC Joint Advisory Group (JAG)
- ISO standardization of OGC specifications: Simple Features Access, Web Mapping Server Interface
- Jointly develop the Imagery & gridded data Reference Model, Framework, and the OGC Sensor Markup Language
- Geography Markup Language (GML)

OpenGIS Consortium (OGC)

- **Non-profit Organisation, founded 1994**
- **US-based, european subsidiary (OGC-E)**
- **Around 258 members from all over the world and different background:**

  IT companies, GIS vendors, Data producers, Mapping agencies, users, universities ..

- **Around 5 TC meetings/year**
- **Members have to agree on decisions**

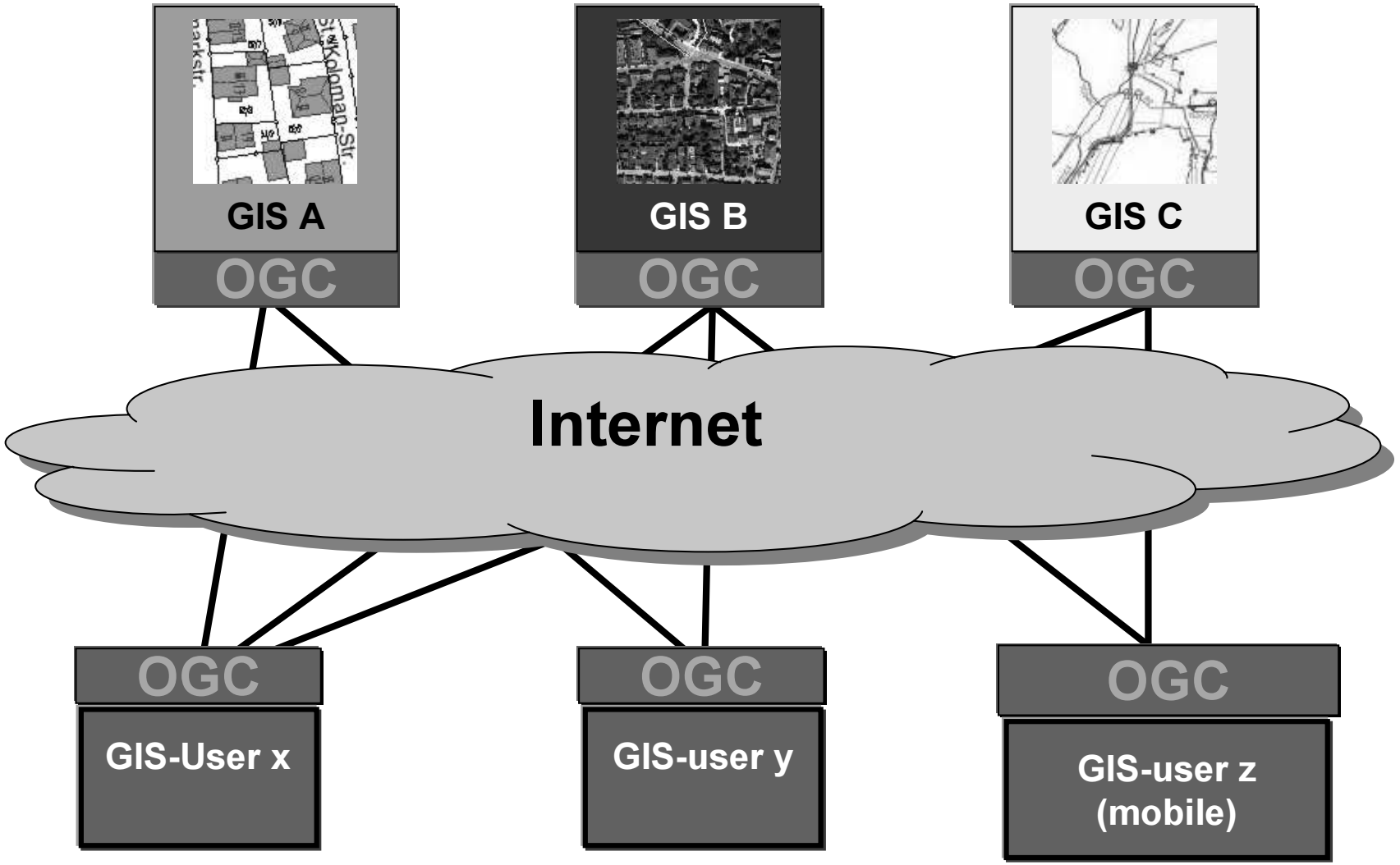
OGC

- **Interface specifications**
- **Communication via standardised interfaces**
- **Trouble free access to heterogenous data**
- **Replace proprietary systems by component software**
- **Promotion of web technologies**

Membership levels:

- **Strategic Members**
- **Principal Membership**
- **Technical Committee Membership**
- **Associate Membership**

Scenario: Distributed Data Bases



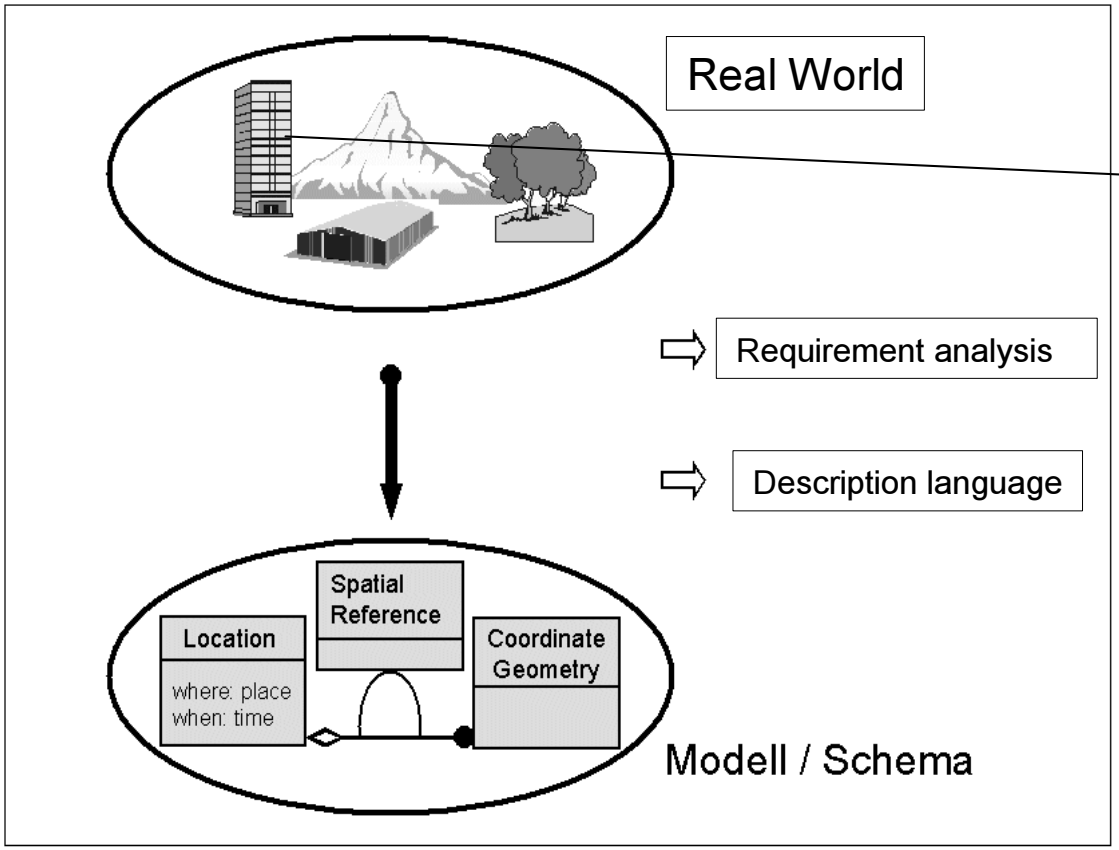
Remark

- Not mentioned: CEN:
  - european Standardisation body
  - Stopped GI work to wait for ISO results
- It is very important because CEN members like GE (I think also CZ?) have to adopt CEN standards! (but not ISO standards)

Why do we need standardisation?

Heterogenous Models / Systems

Modelling



Buildung
Adress
Age
No. of floors
GeomType: Polygon

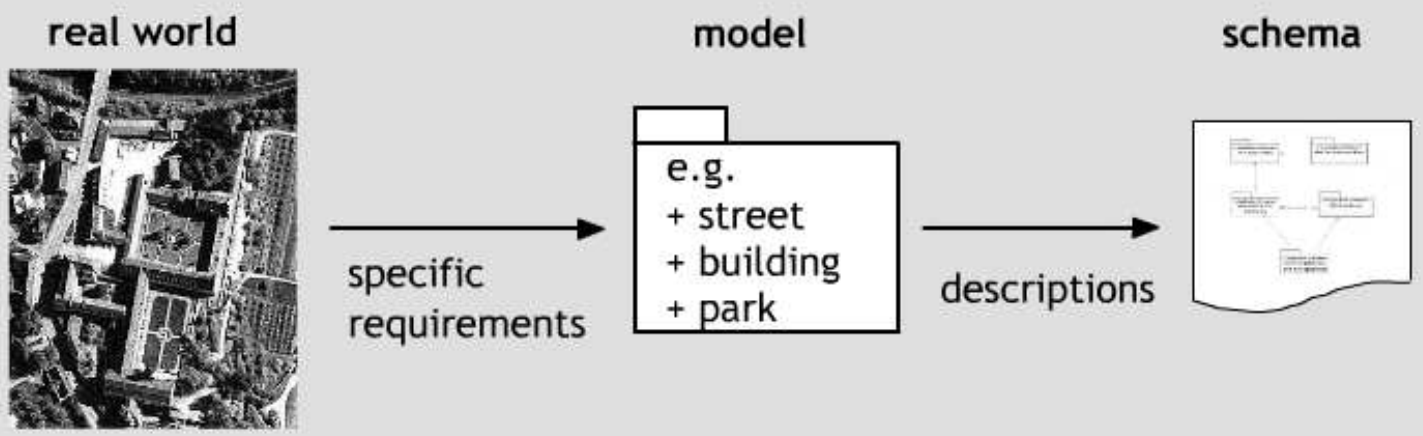
Example

Schema: describes the model, usage of standardised languages

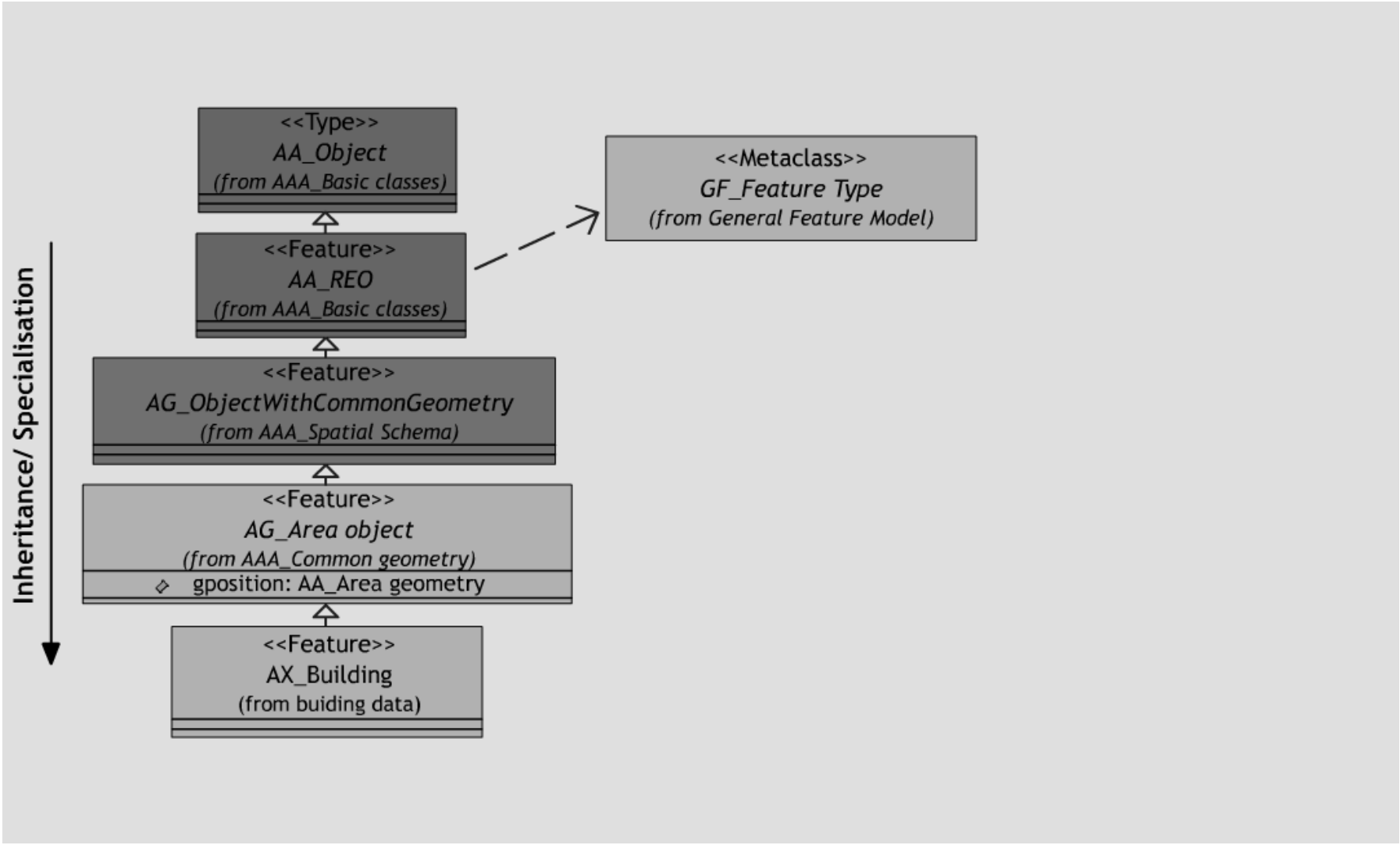
Modelling

!

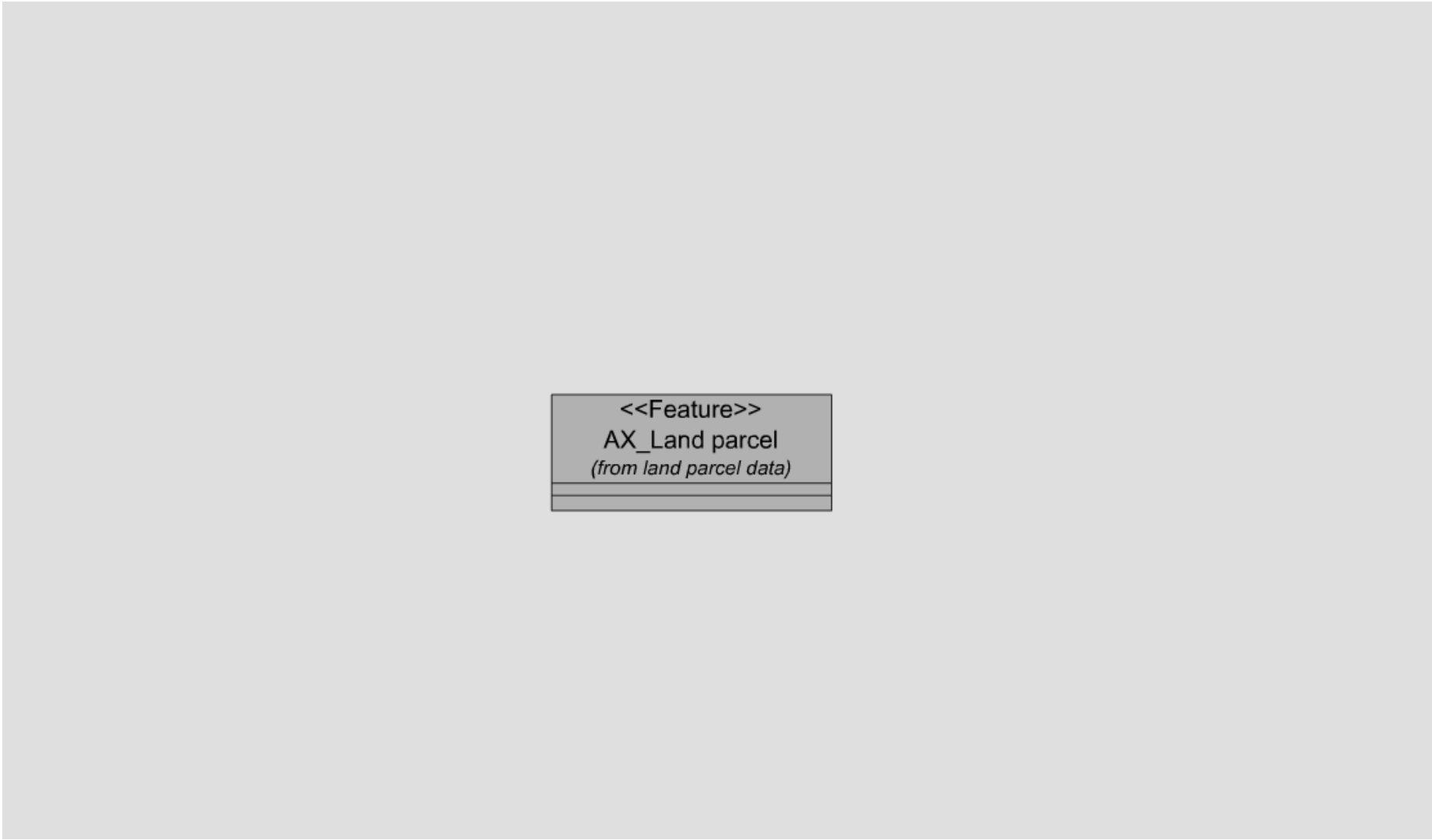
Abstraction of phenomena of the „real world": called geo-objects or Features



Generalisation/ Specialisation



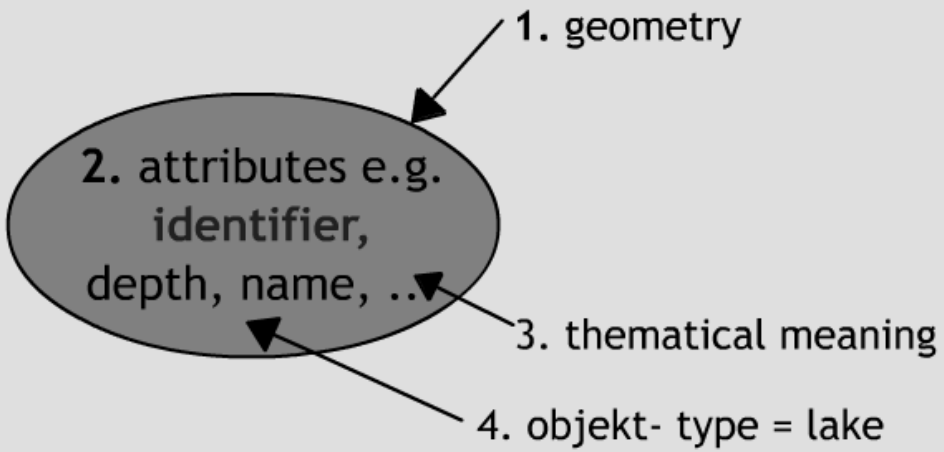
Relations of land parcels



Objects with spatial reference

Every geo-object :

1. Includes a spatial reference (characterised by geometry)
2. Has a "thematical meaning"
3. Includes other thematic data (attributes)
4. Includes other information (e.g. references)



An example of different modelling

Depending on the application domain, there might be a different modelling of the object "lake":

application domain A

model A

attributes:

- name
- area
- max. depth
- protected

application domain B

model B

attributes:

- name
- area
- max. depth
- average temperature
- water quality
- pH-value
- vegetation

Different terms and meanings

Depending on the application domain, geo-objects may have different meanings:

application domain A

model A

object = lake

attributes:

- `name`
- `area`
- `max. depth`
- `protected`

application domain B

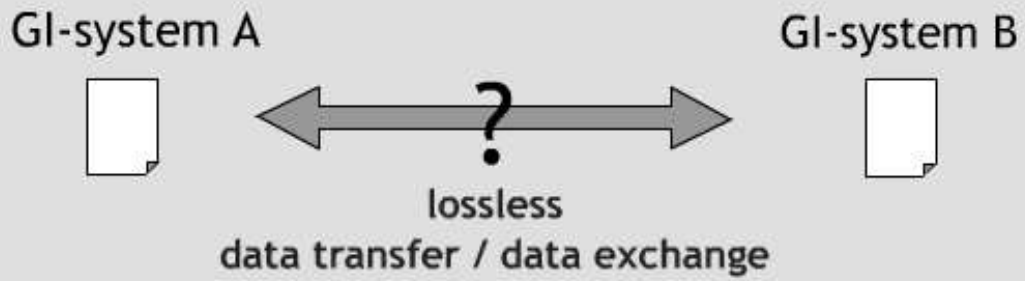
model B

object = fish pond

attributes:

- `size`
- `fish species`

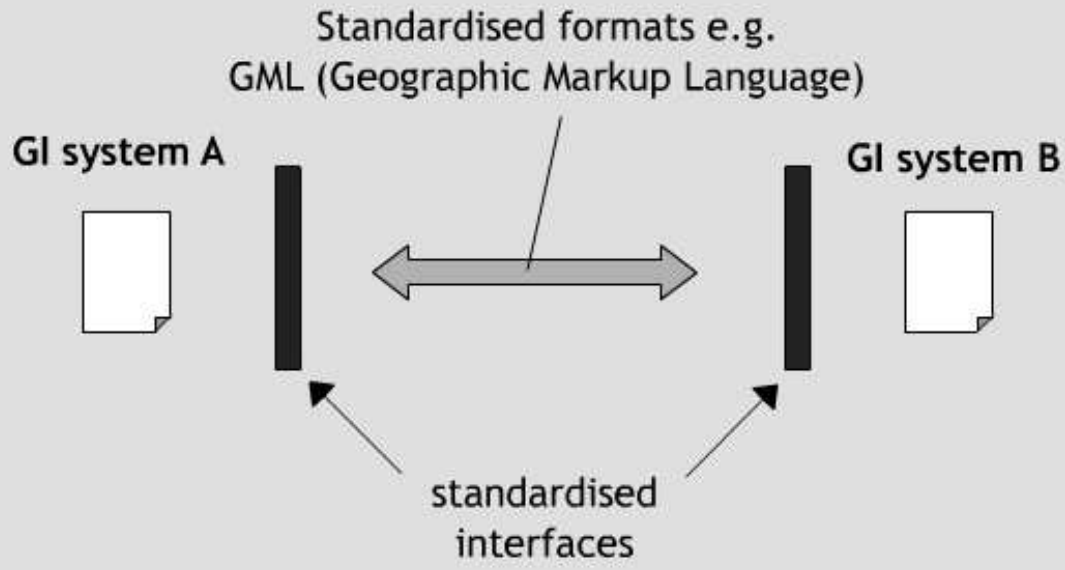
Problems with data exchange



Problems of heterogenous systems:

- Different file formats **(„syntax“)**
- Different possibilities for modelling
- Different conceptual models
  - different views of the real world in different application domains
  - different requirements

Goals of data exchange



Purpose: data transfer without loss of information by
- standardised interfaces
- standardised formats

Additional requirement: Transfer of schema (description of the model)

Different kinds of data exchange

Data based exchange:

- Only data is transferred
- Models must be known
- Often: conversion to standard formats like DXF

Model based exchange:

- Schema information and data is transferred
- Sophisticated data description language is required, which allows for standardised descriptions of schema and data (e.g.GML).

Examples of syntax: programming

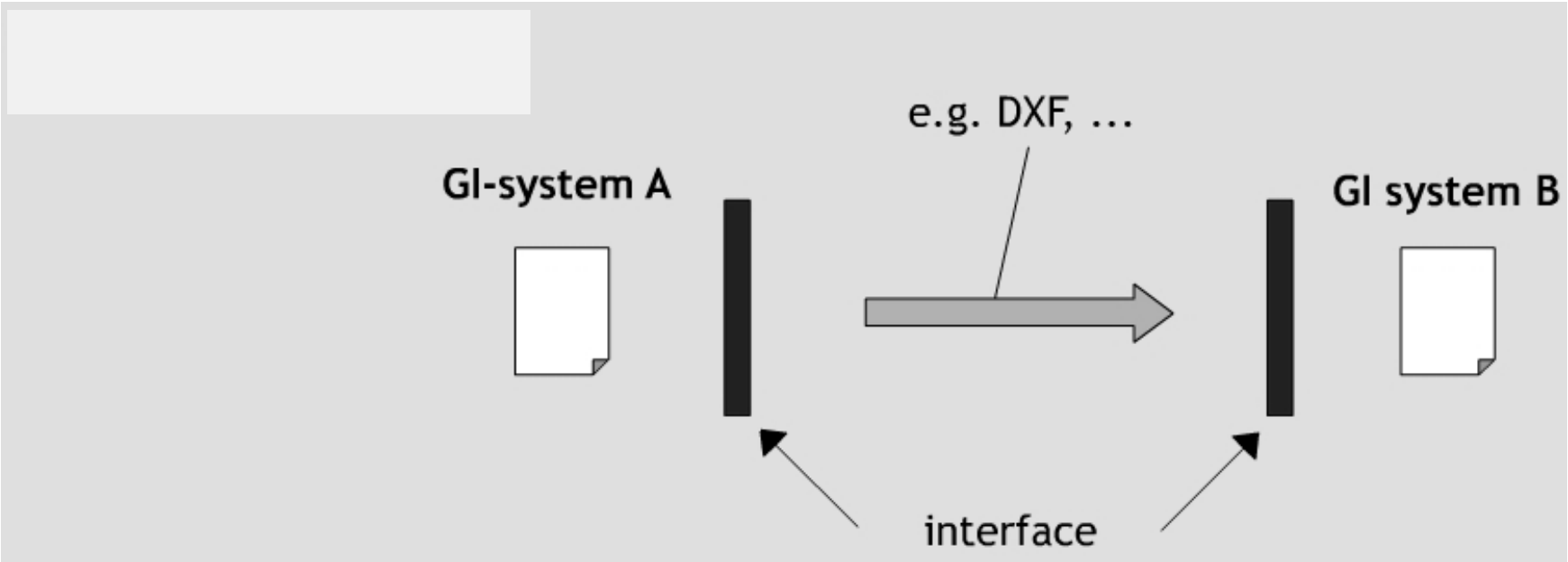
C++ programming:

```
// my first program in C++

#Include <iostream.h>
 int main ()
 {
     cout << "Hello World!";
     return 0;
  }
```

Java programming:

```
Hello.java

public class Hello
 {
   public static void main(string []args)
   {System.out.println("Hello World!");}
 }
```

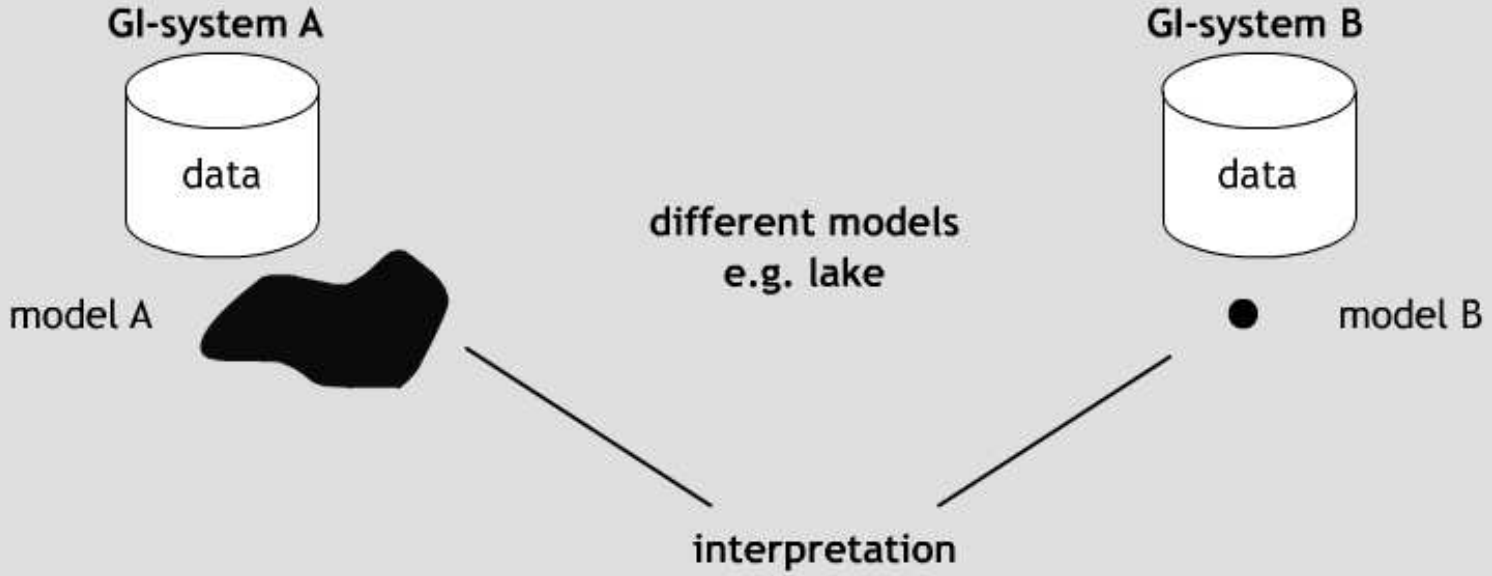
Syntactical interoperability



Syntactical interoperability means the ability of information systems to exchange data without loss of information under the pre condition that the data schema and the semantics in the systems are identical or at least known.

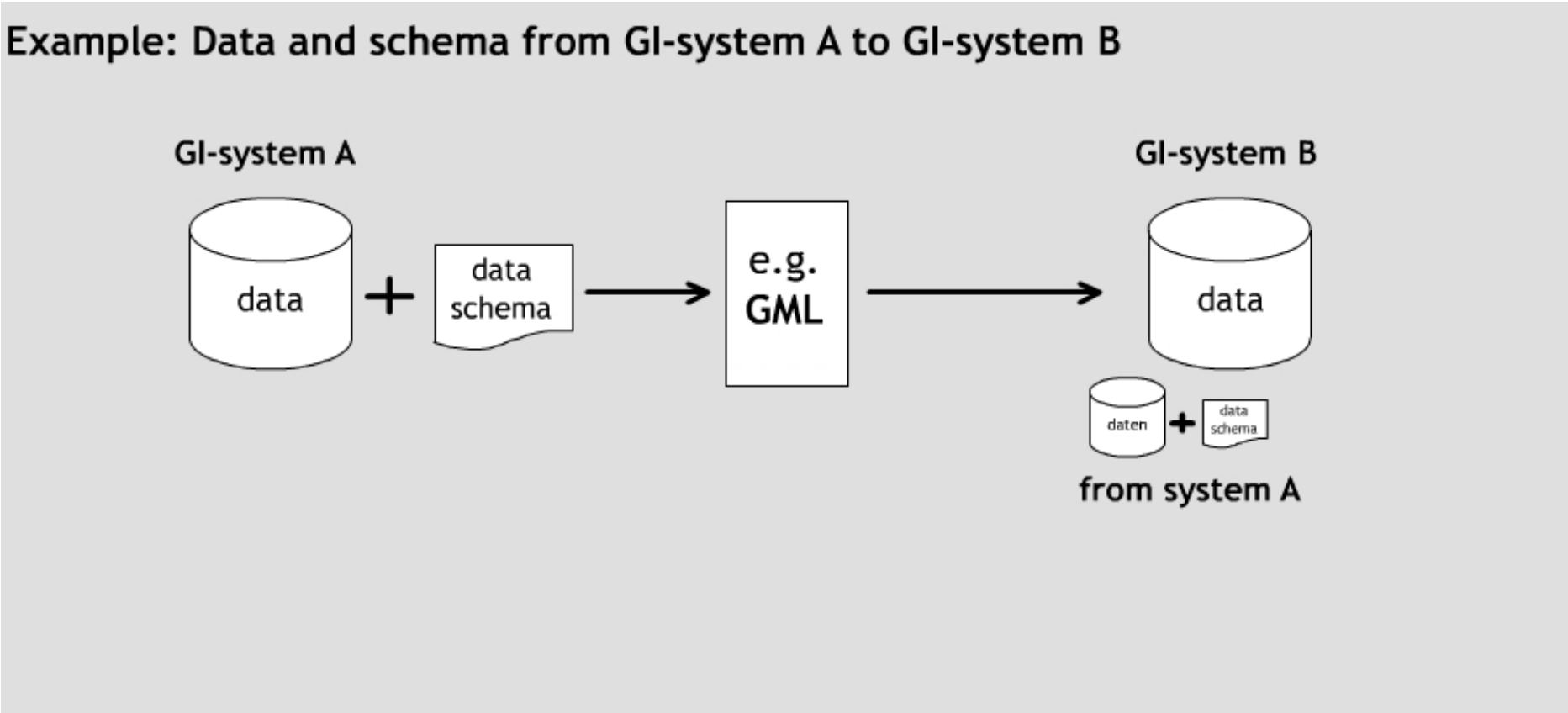
Schema based interoperability 1

Example:
Two GI-systems with different data schema according to their user domains



Notice: Interoperabilty can only be provided by means of individual solutions (in the example only in one direction)

Schema based interoperability 2



Notice: In this special case System B adopts data and schema from System A

(not a „real“ interoperabilty problem).

Semantical Interoperability

Example: flood information system - visualisation and simulation of water- levels in a rivershed. There are 3 different data sources, which must be combined.
How can this problem be solved ?

Interoperability

3 levels:

- Syntax
- Schema
- Semantics

Definitionen Interoperabilität

Definitionen:

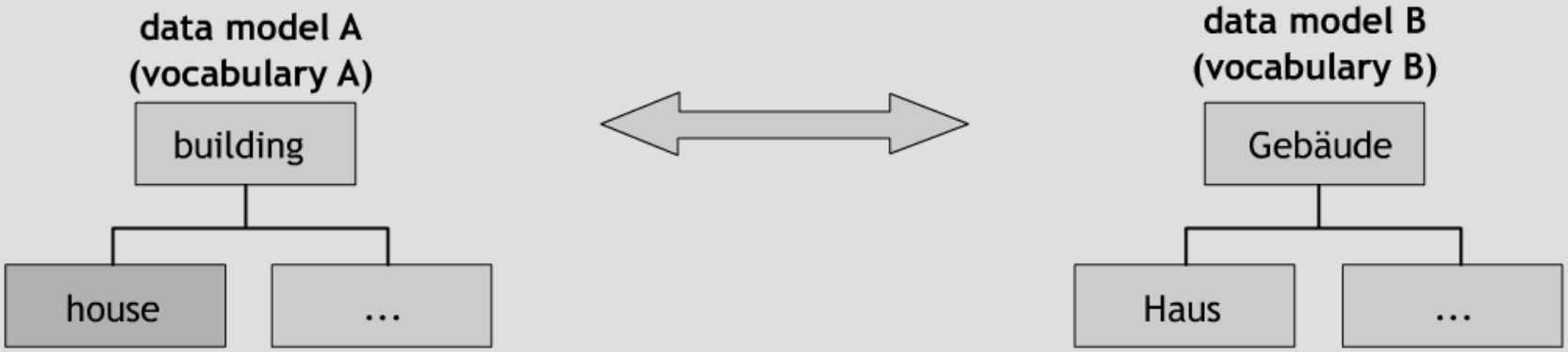
Interoperability is „the ability of information systems to operate in conjunction with each other encompassing communication protocols, hardware, software, application and data compatibility layers“.
(**Quelle:** Glossary - ANVIL: A Networked Virtual Interoperability Laboratory)

Interoperability is the ability of two or more systems to exchange geospatial information and to make mutual use of the information that has been exchanged.
(**Quelle:** Bishr, 1997)

Interoperabilität ist die Fähigkeit eines Informationssystems oder von System-komponenten, Daten und Funktionen über Systemgrenzen hinweg auszutauschen und nutzen zu können.

Problems of semantics in different systems

example A: different terms for identical object classes (identical meanings)



Problems of semantics in different systems

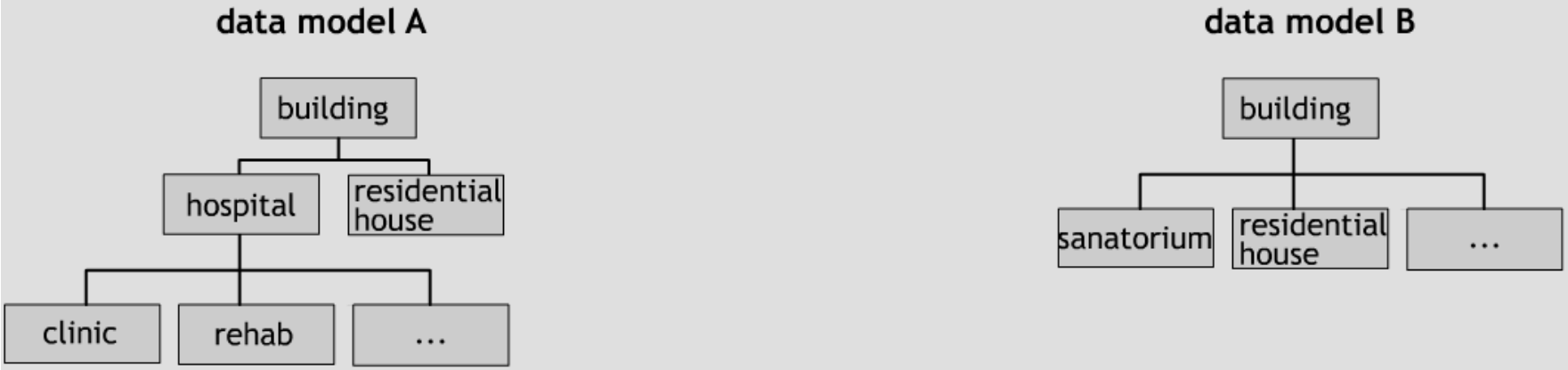
example B: different meanings for identical terms (identical object classes)

data model A: lake = lake for bathing, fish pond, reservoir, ... (lake with different meanings)
data model B: lake = recreation area, sanctuary, ...

Ambiguity of terms

Example: hospital

data model A: building = hospital (clinic, rehabilitation centre,...)
data model B: building = sanatorium



Ontology in GI:

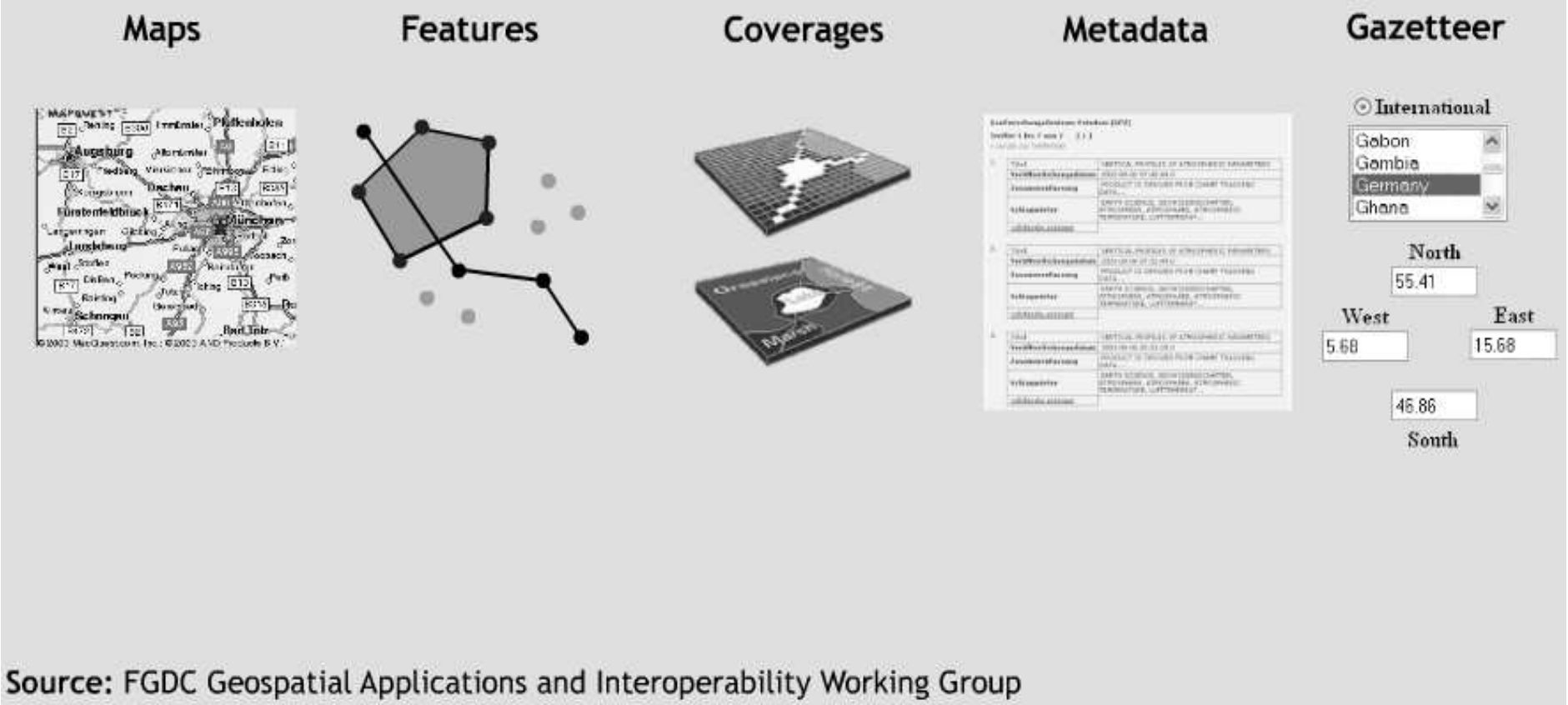
Used to describe semantics

How?

Examples of specifications

WMS / WFS

Modelling



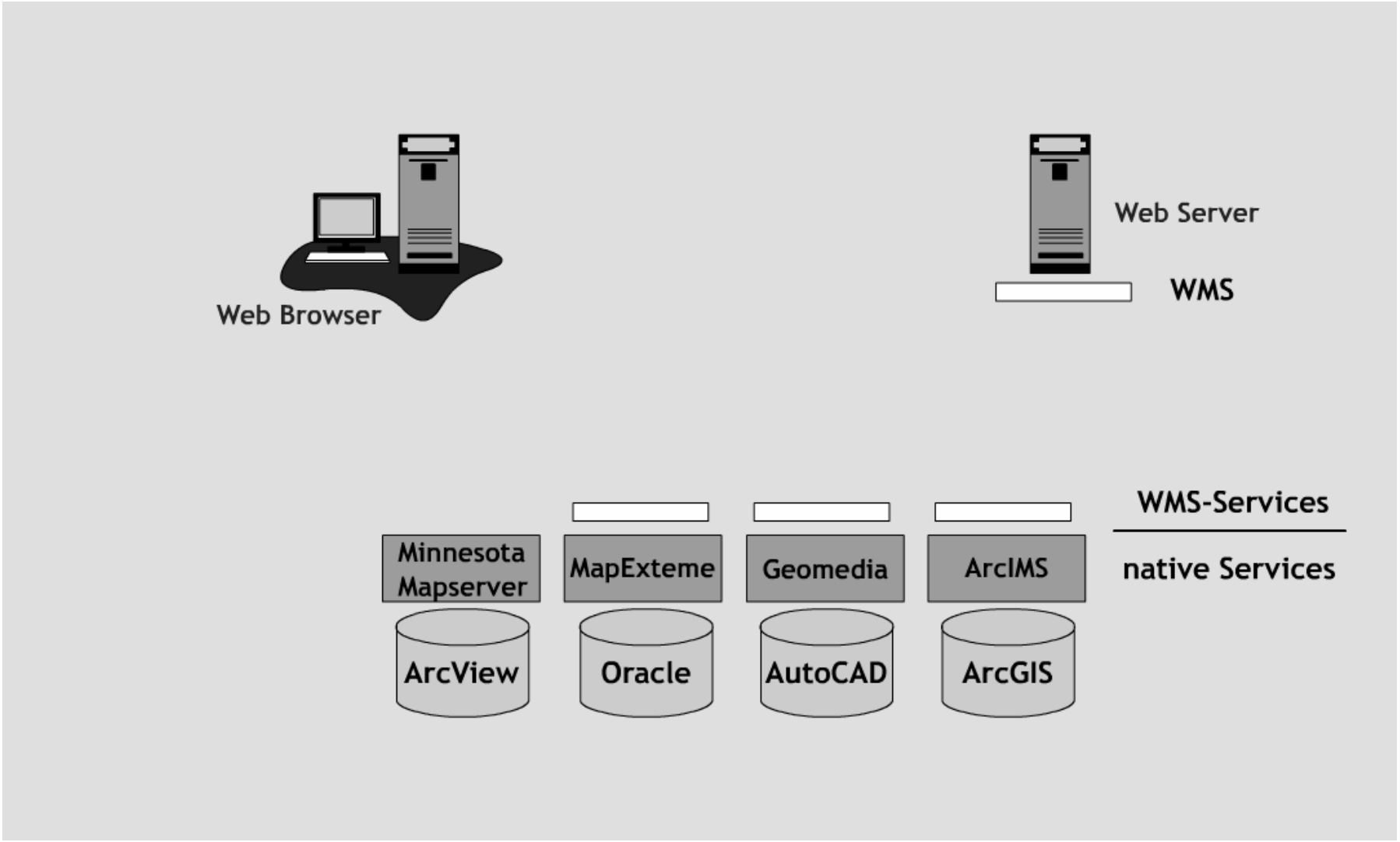
Source: FGDC Geospatial Applications and Interoperability Working Group

OpenGIS Webservice specification

OpenGIS "Implementation Specifications" for the transmission of Geodata:

The syntax of each request is specified

Geodata access using WMS- Services



WMS Request

- `getCapabilities` (obligatory): Reference to Metadata of the WMS- content. Used for requesting the possibilities of the services.

The syntax of the WMS- Request

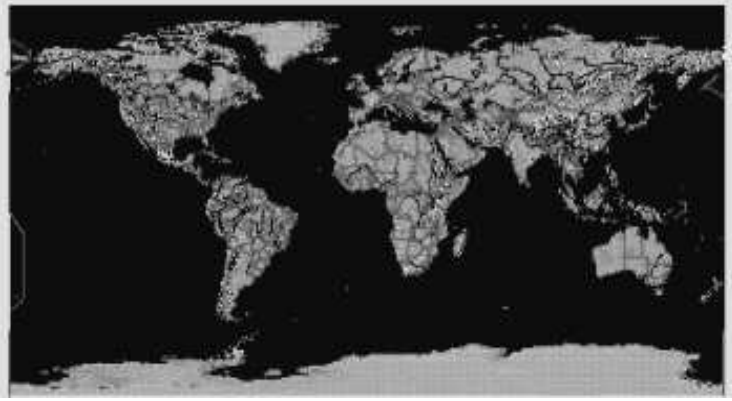
- The WMS request (e.g., "getMap") is based on the HTTP Common Gateway Interface (CGI) Form Request, displayed as URL with question mark.

```
http://clearinghouse1.fgdc.gov/scripts/ogc/ms.pl?version=1.1.1&
```

Protocol — Server of the Data provider — Implementation (e.g. Perl/CGI) — Parameter

- The question mark is followed by a list of parameters (pairs of key-values) with the format "Key = Value". Includes the URL of serveral parameters. These are seperated by a &- character.

```
version=1.1.1&
request=getMap&
srs=EPSG:4326&
bBox=-180,-90,180,90&
width=400&height=200&
format=JPEG&
styles=BLACK&
layers=boundary,elevation,lakes,rivers
```



WMS- Request examples – getMap (map)

URL: `http://clearinghouse1.fgdc.gov/scripts/ogc/ms.pl?version=1.1.1&request=map&srs=EPSG:4326&bBox=-180,-90,180,90&width=600&height=300&format=JPEG&layers=boundary,coastline,elevation,lakes,rivers&`

Demo:

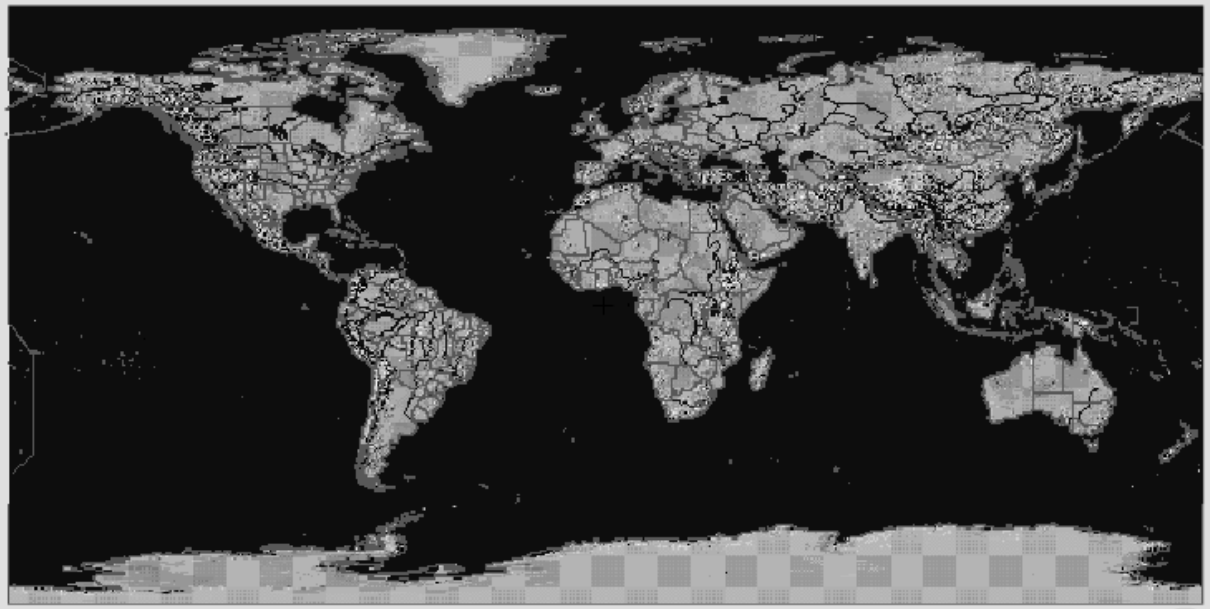
- World map (all layers active)

  Zoom in (zoom factor 2)

  Masking a layer

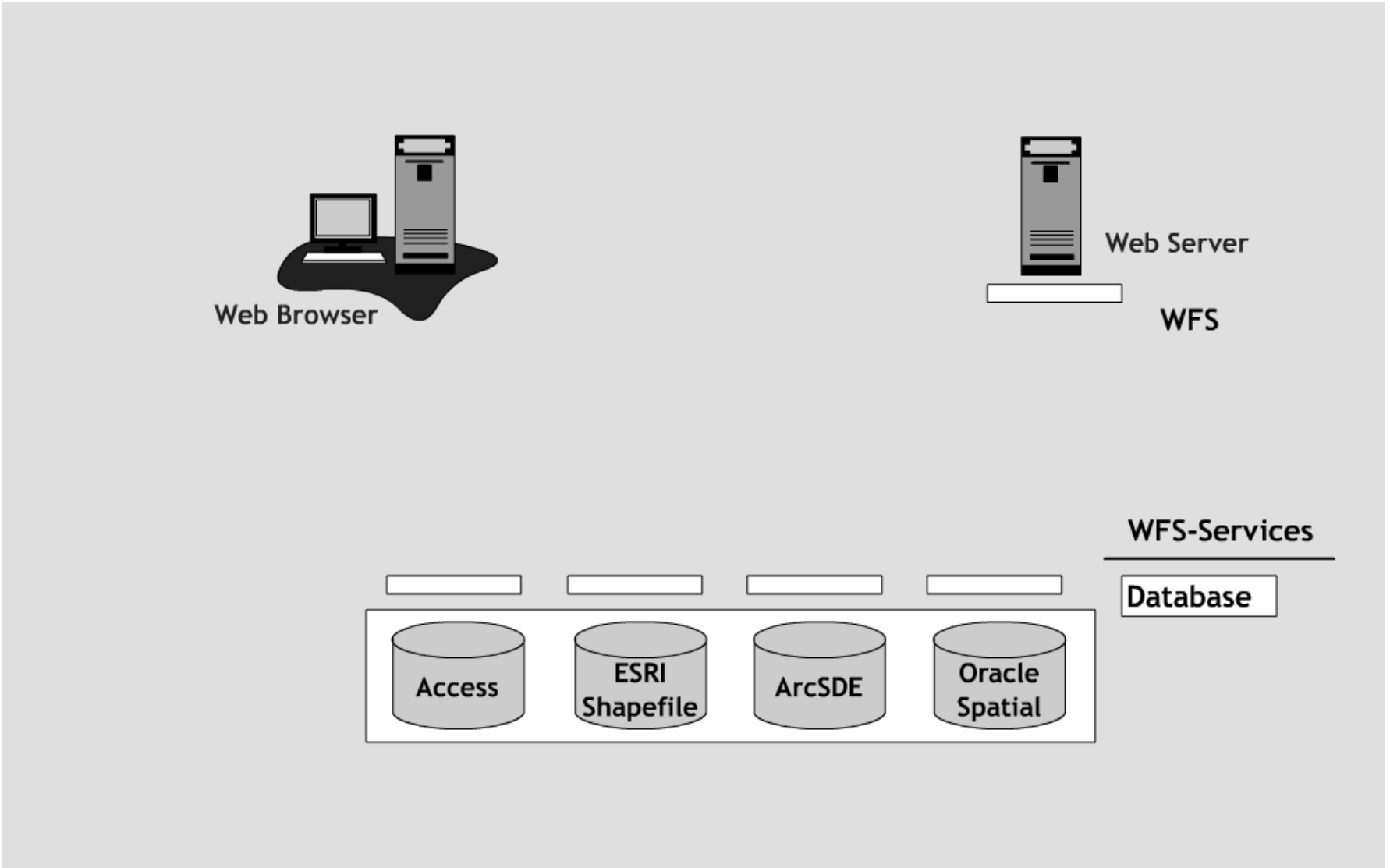
  Zoom & Pan

  Changing the size of the map



zum Anfang

Geodata access using WFS- Services



Another important specification:

GML (Geographic Markup Language): (>>http://www.opengis.org) Example:

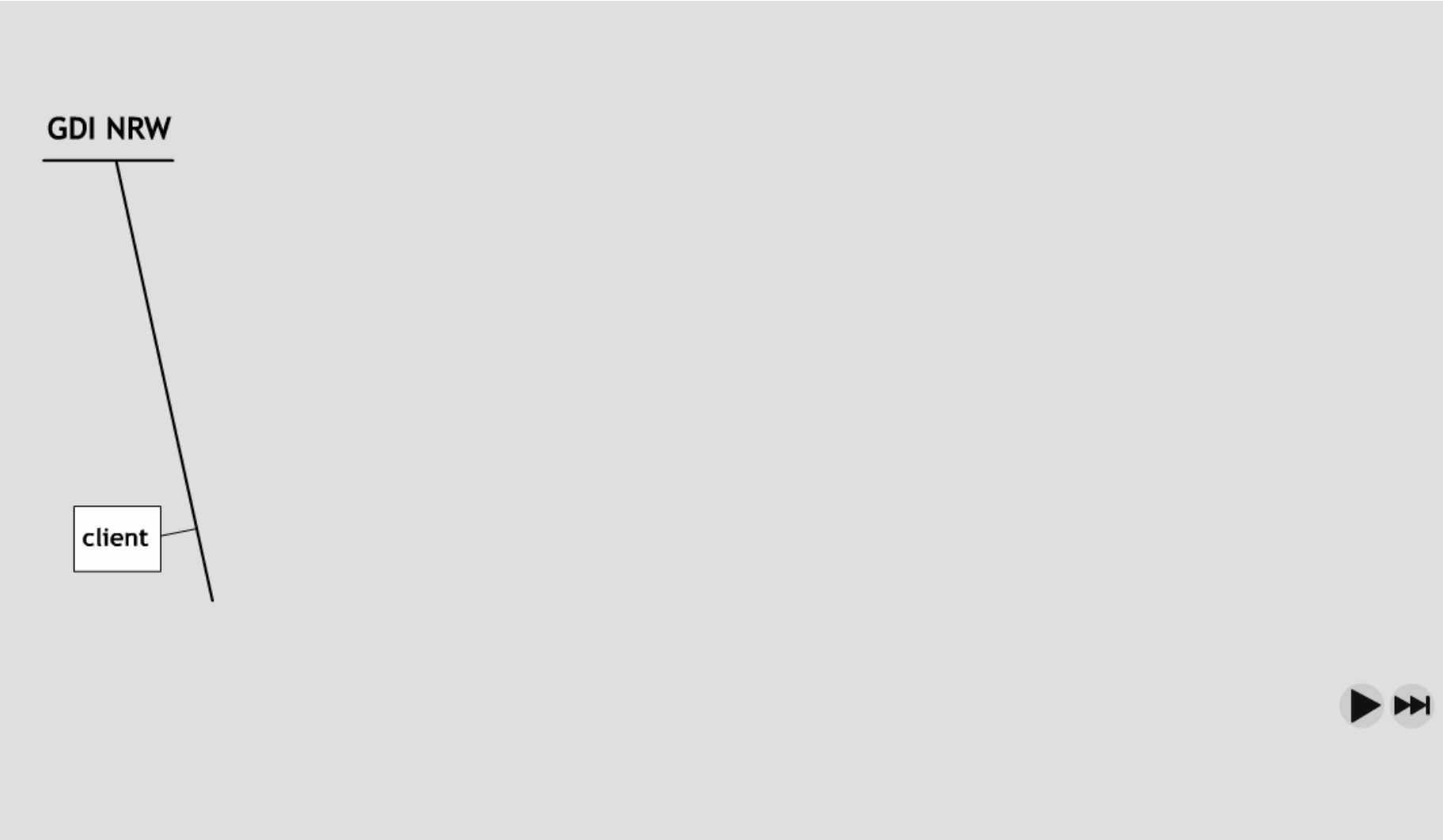
```
<Feature fid=„342" featureType=„school" Description="A middle school">
  <Polygon name="extent" srsName="epsg:27354">
      <LineString name="extent" srsName="epsg:27354">
        <CData>
        491888.999999459,5458045.99963358
        ...
        </CData>
      </LineString>
  </Polygon>
</Feature>
```

⇨ Used in WFS!

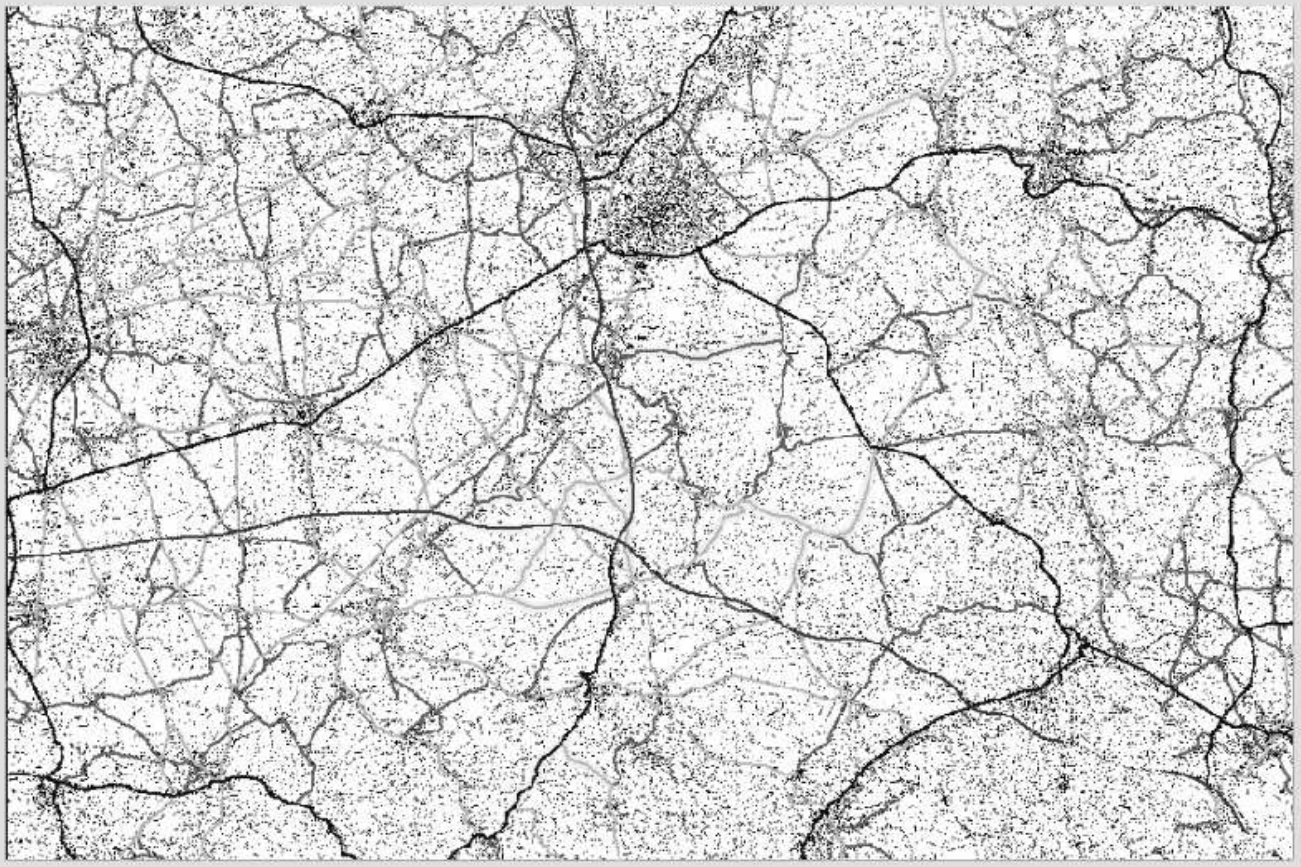
⇨ Also very important as transfer format!

WMS/ WFS example – “Scenario Lothar“

WMS/ WFS example of use



WMS/ WFS example of use - result



Remark

- Scenario has changed (distributed processing)
- Conventionally all the data had to be transferred to a GIS!

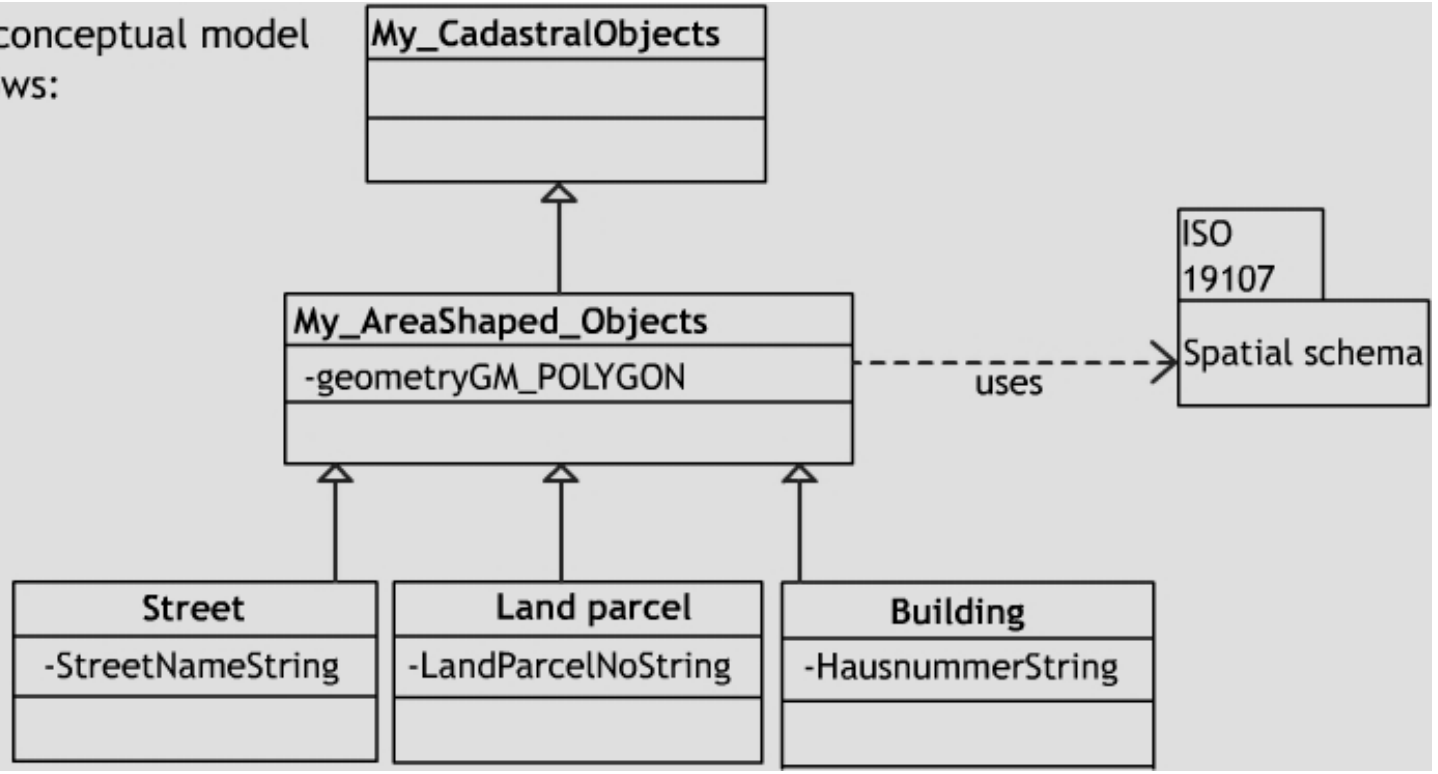
How to use?

Examples

Example: real world

Example: Conceptual model

The corresponding conceptual model may appear as follows:



Example: Implementation

The following schematised presented tables show
the Implementation of this Conceptual Model
in Microsoft Access.

Application scenario 1: notary's office

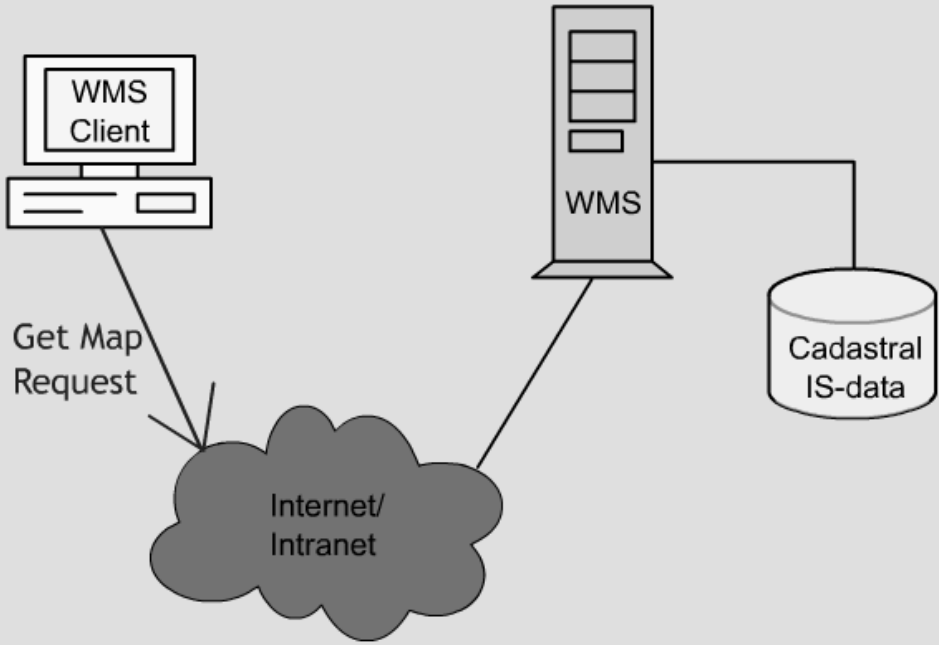
Requirements:

Question:

Solution:

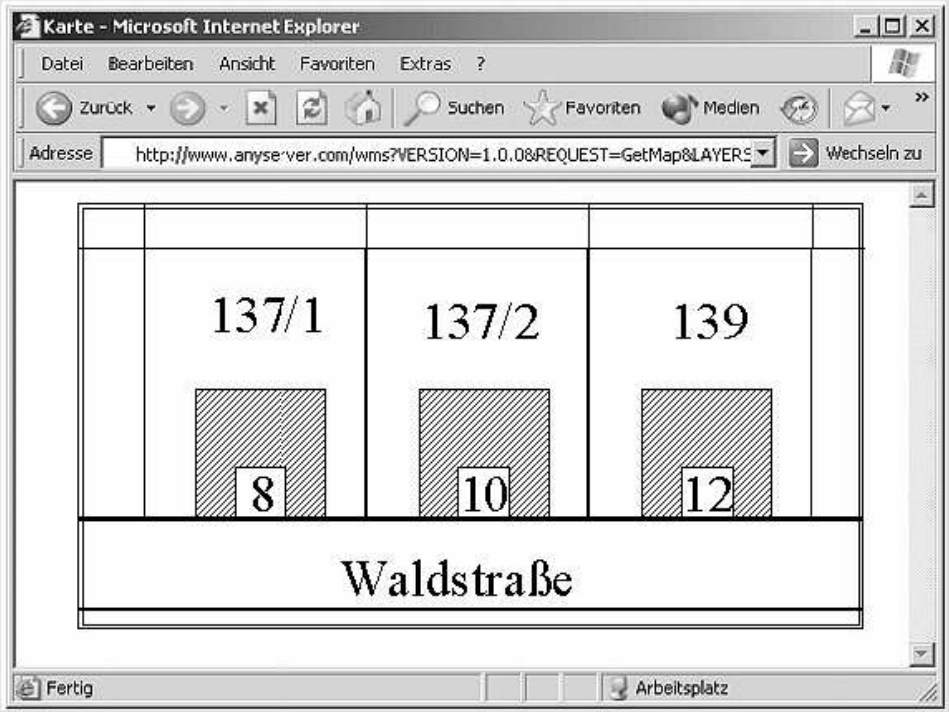
Application scenario 1: Workflow of the WMS request

- The client posts a Get Map Request and transmits it to the WMS.



Application scenario 1: Result of the WMS request

The image to the right shows the display of the requested map on the Webbrowser of the notary´s office. It includes the neighbourhood real estates of the land parcel 137/2 .



Application scenario 2: Power Authority

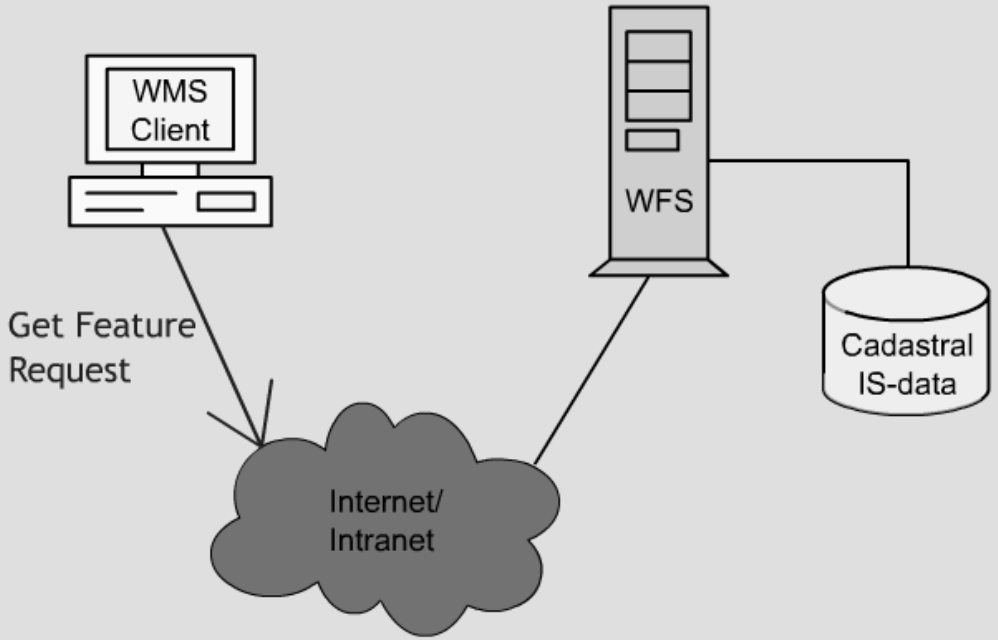
Requirements:

Question:

Solution:

Application scenario 2: Workflow of the WFS request

- The client posts a Get Feature Request and transmits it to the WFS.



Application scenario 2: Result of the WFS request

The picture below shows a section of the cadastral data in GML.

This data can now be integrated in the existing set of Geodata of the energy supply company. Furthermore it can be visualised in a GIS.

```
...
<property typeName="houseNo" type="string">8</property>
<gml:Polygon xmlns:gml="http://www.opengis.net/gml"
   srsName="http://www.opengis.net/gml/epsg.xml#4326">
   <gml:outerBoundaryIs>
         <gml:LinearRing>
               <gml:coordinates cs="," decimal="." ts=" ">
                     10.4,10.3 10.4,10.7 10.8,10.3 10.8,10.7
               </gml:coordinates>
         </gml:LinearRing>
   </gml:outerBoundaryIs>
</gml:Polygon>
...
```

Situation in Practise?

Hundreds of WMS implementations

WFS just starts

GML becomes more and more important

RT-GIS – Practise test - WMS

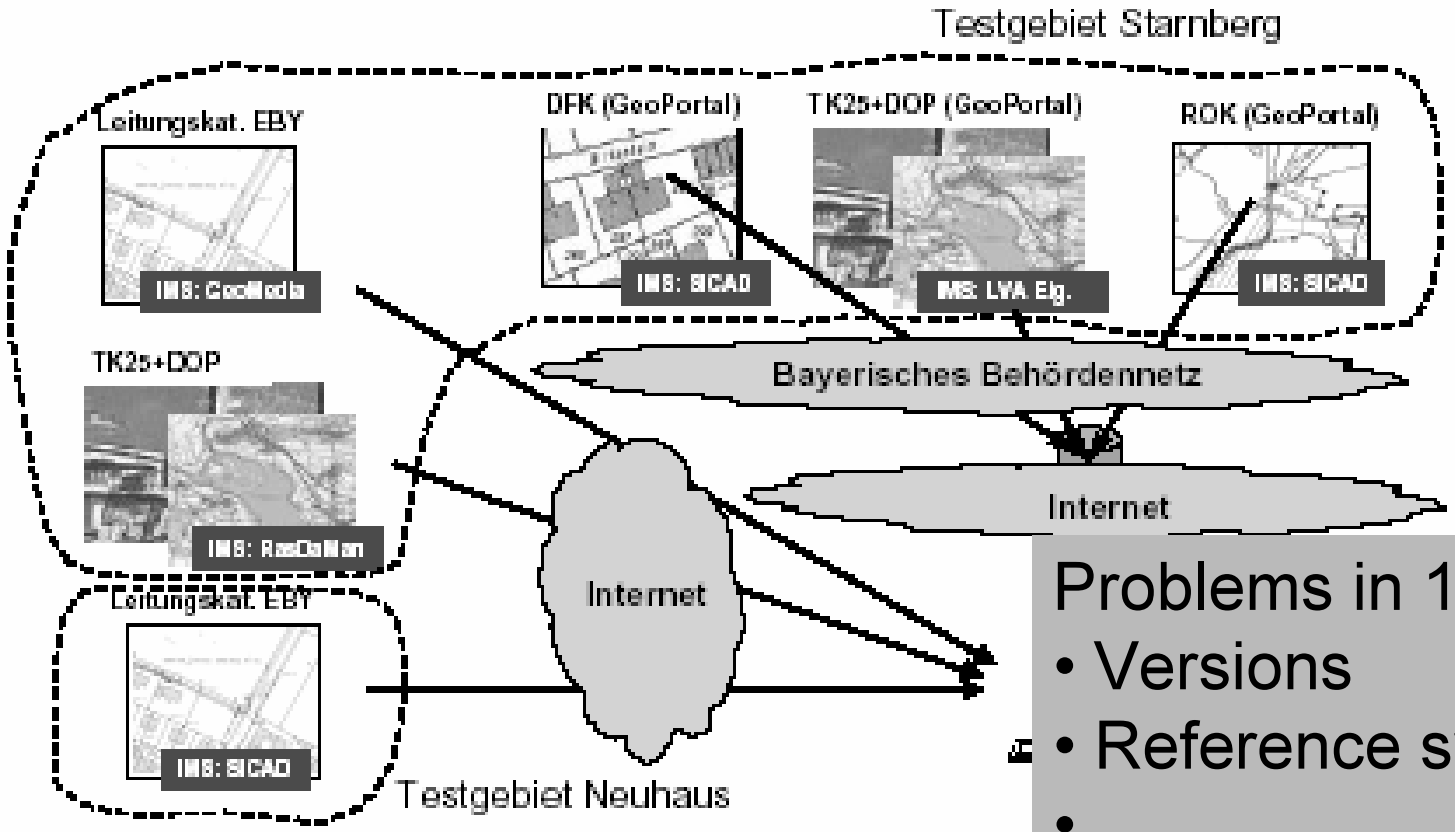
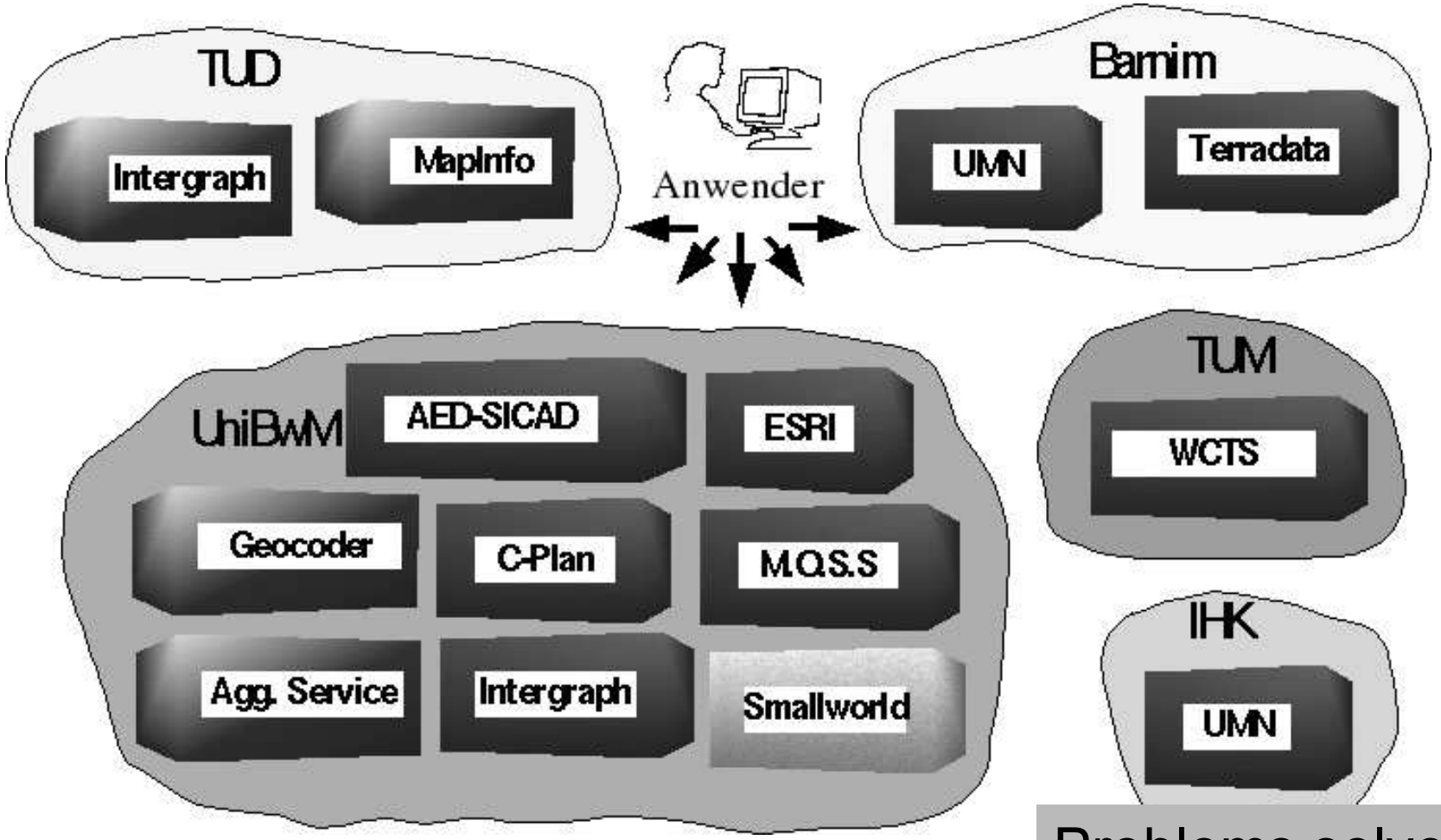


Abbildung 1: Infrastruktur im Projekt OpenGIS im Praxistest

Problems in 1. test:
- Versions
- Reference systems
- …

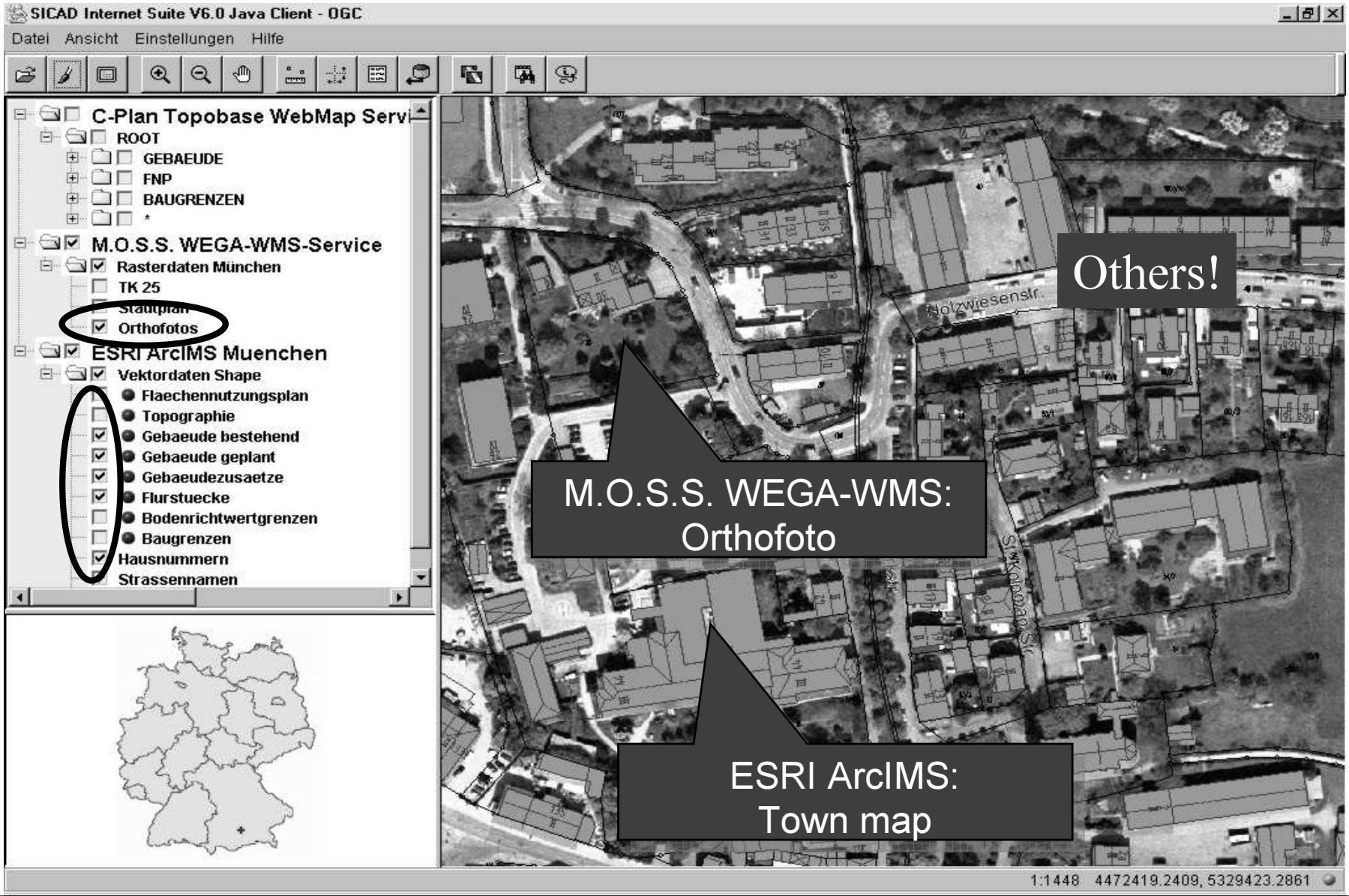
src: Gunnar Teege, 8. Münchner Fortbildungsseminar, 2003

RT-GIS – practise test - WMS



Problems solved!

RT-GIS – practise test -WMS



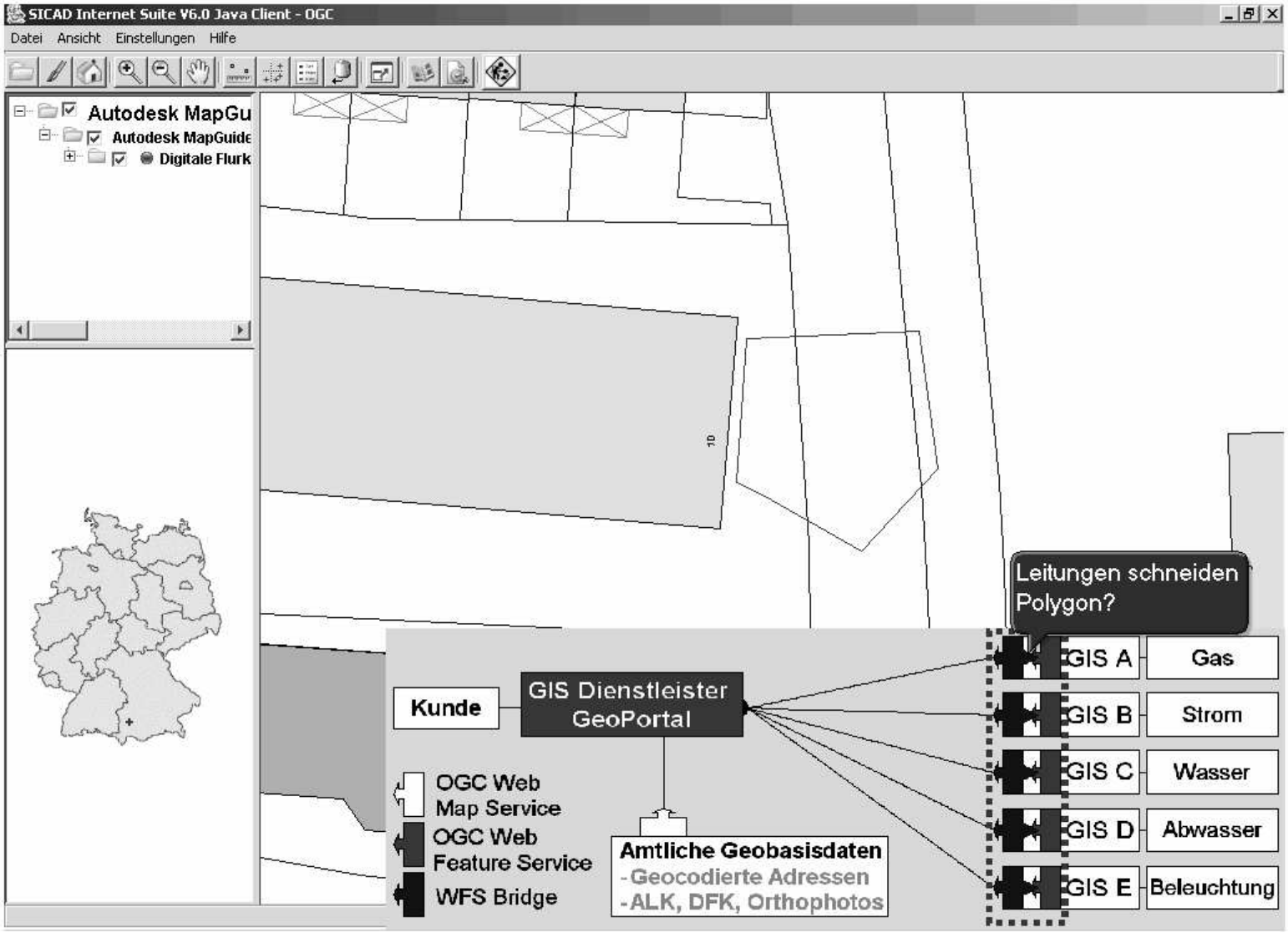
RT-GIS – practise test - WMS

General result:

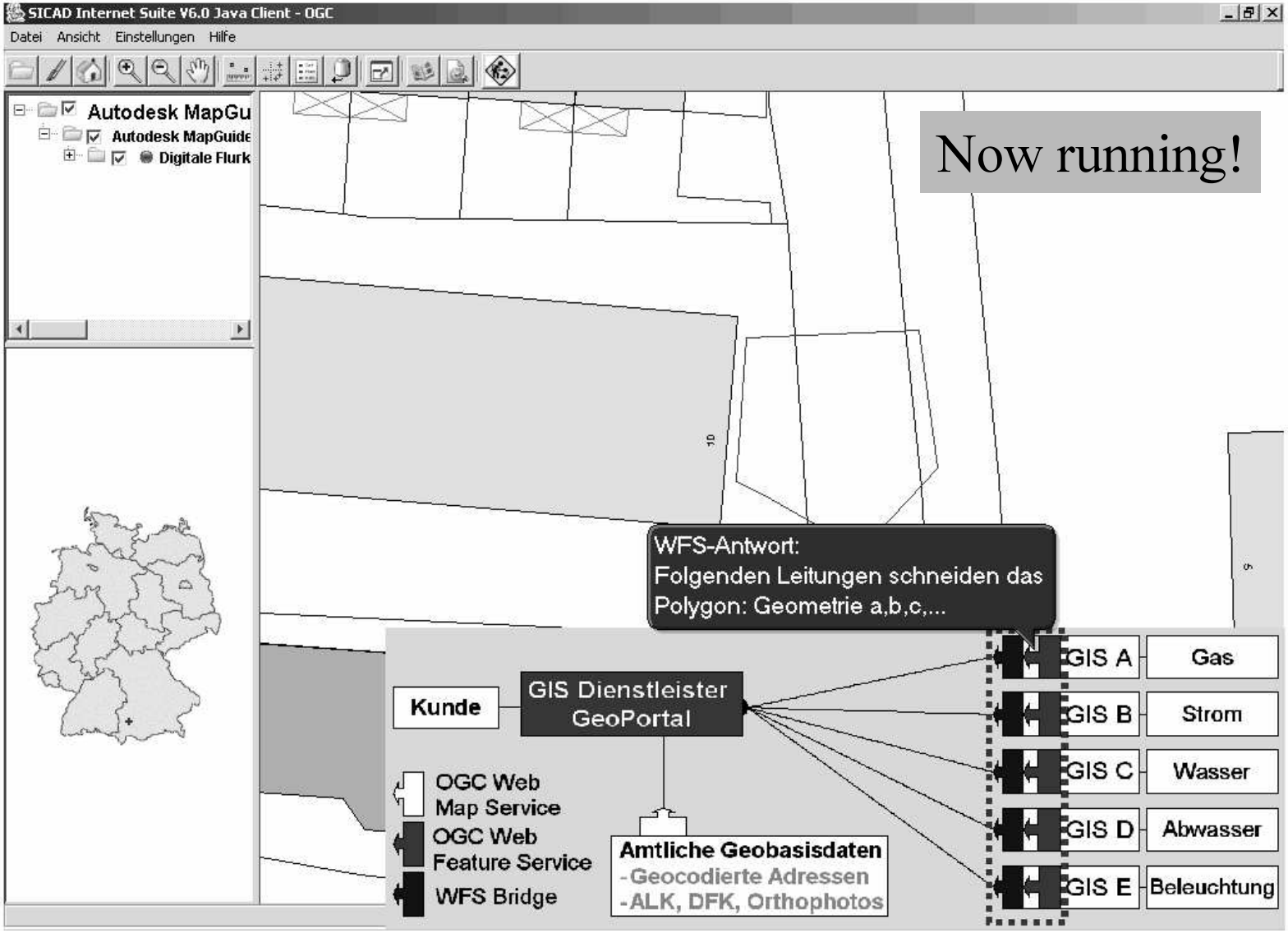
- Distributed data bases in different vendor systems can be used via Map Services „smoothly“
- Benefits of this solution could be shown

src: A. Donaubauer et. Al, RT-GIS Intergeo 2004 -Präsentation

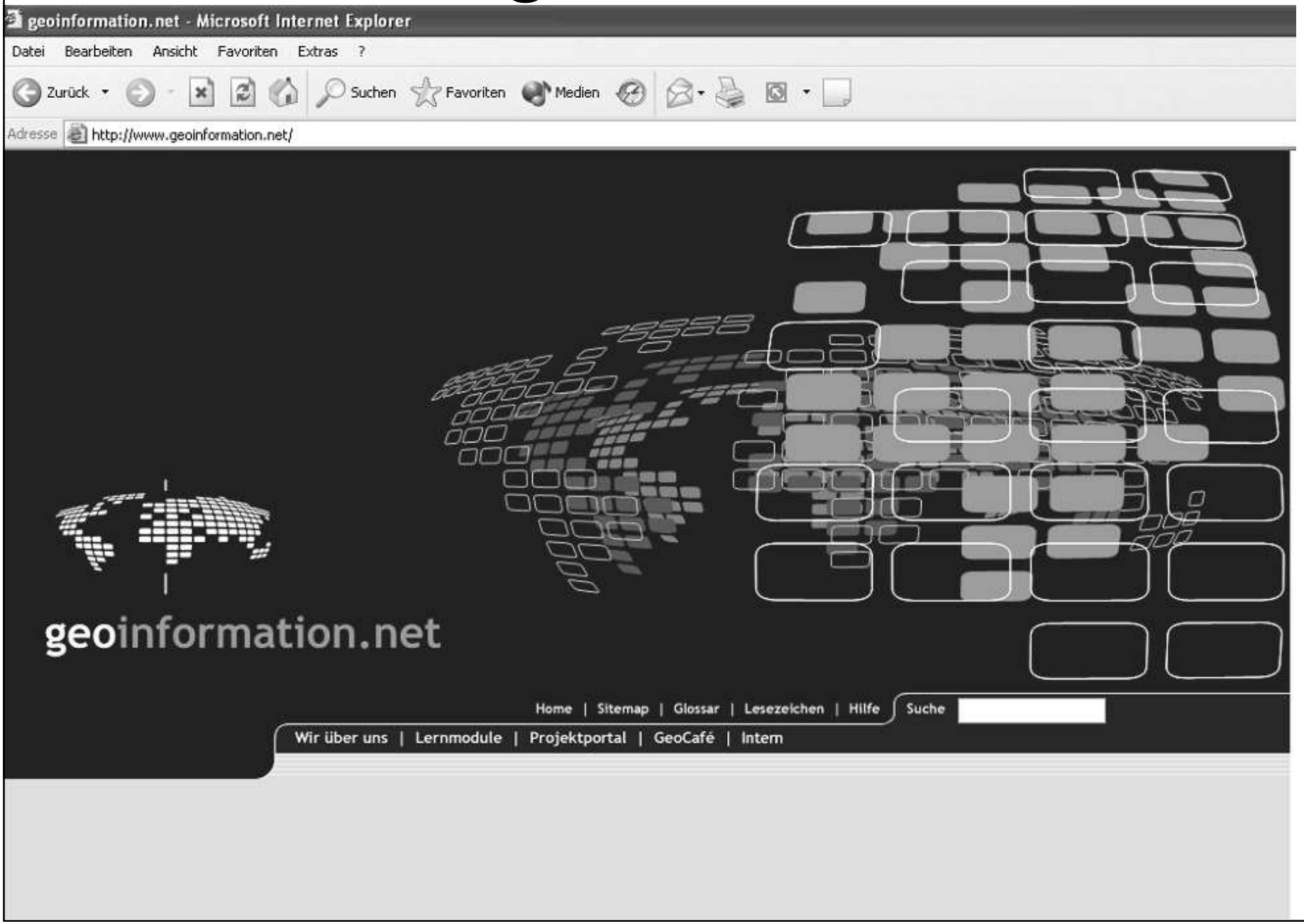
RT-GIS – practise test - WFS



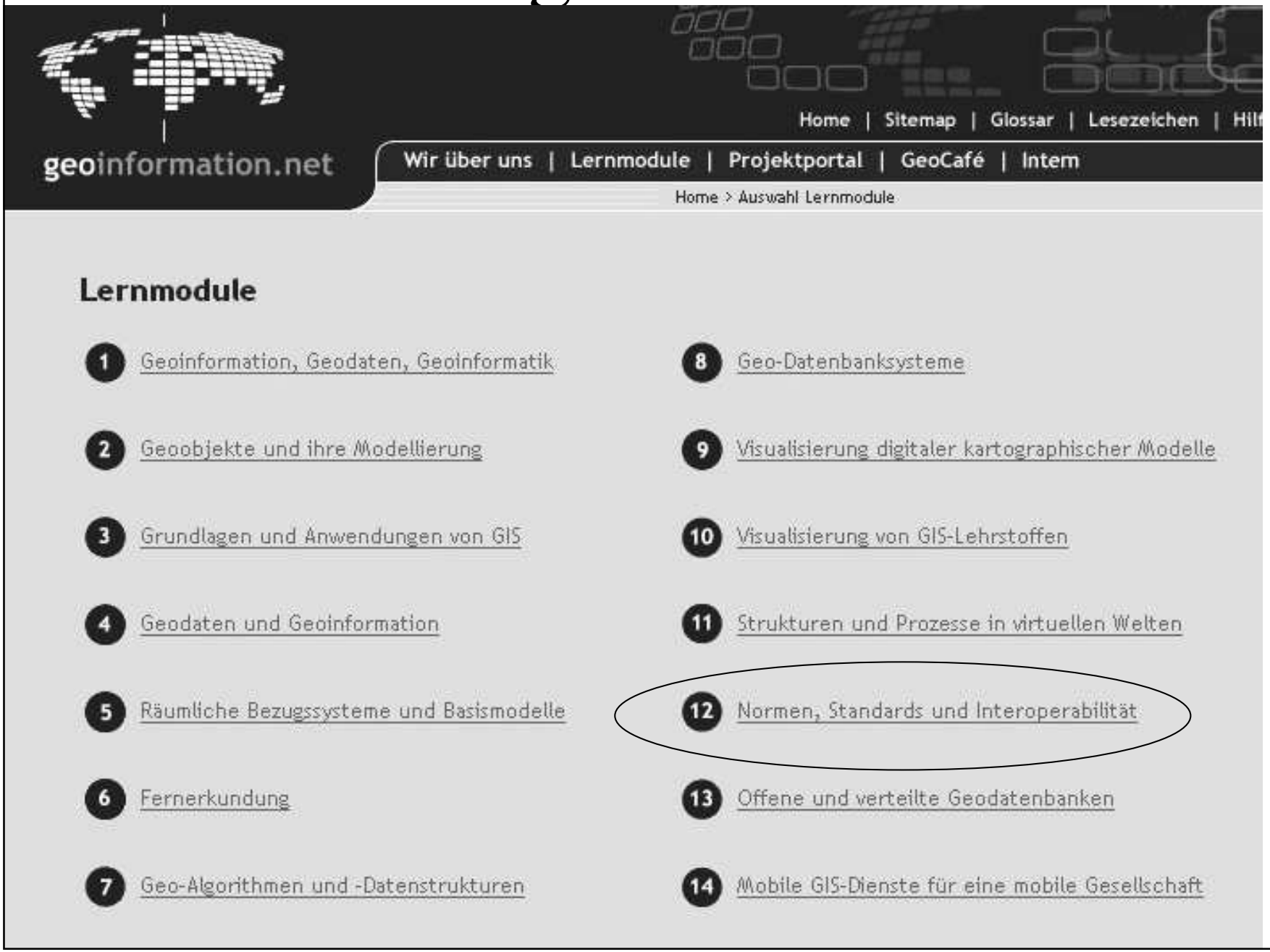
RT-GIS – practise test - WFS



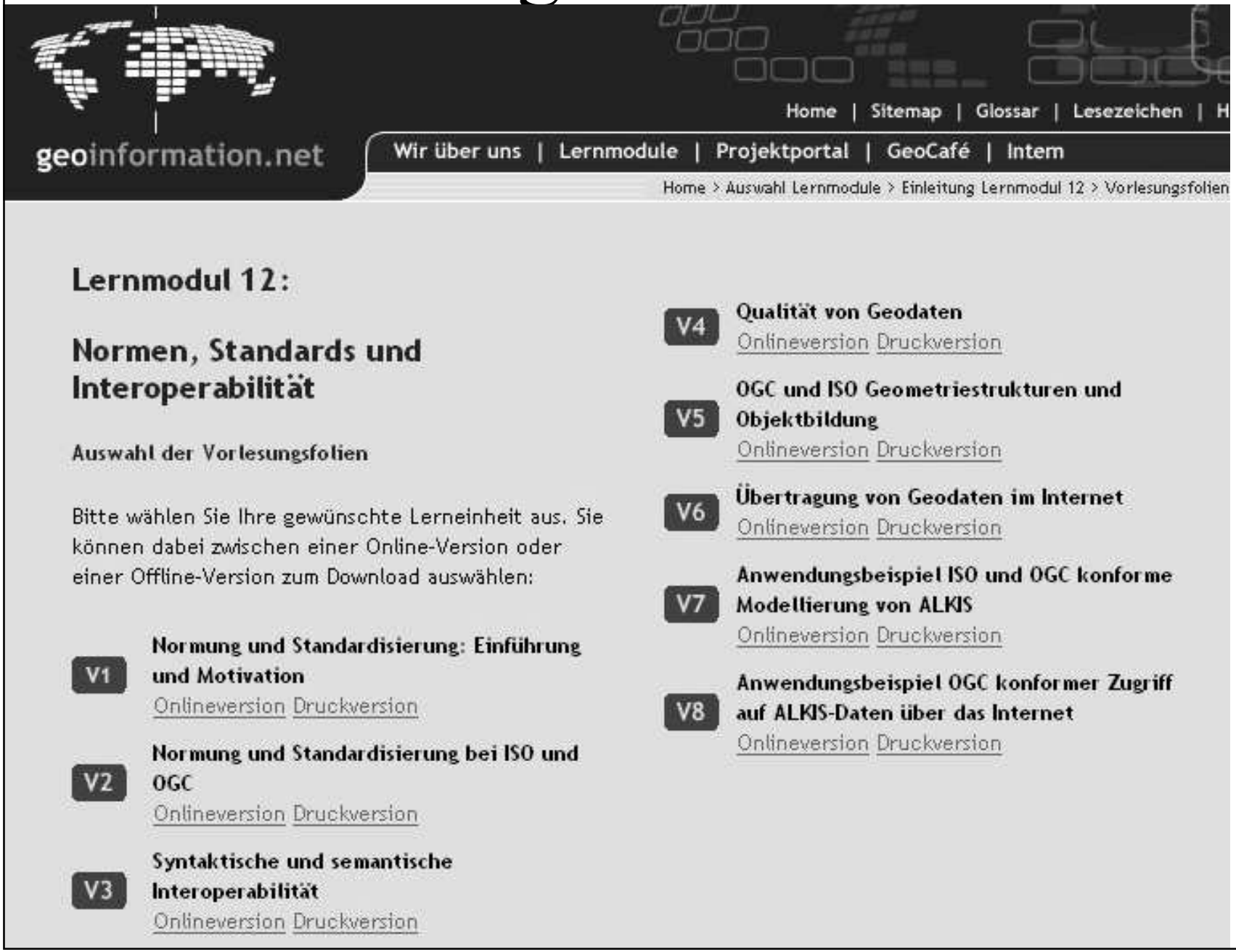
www.geoinformation.net



www.geoinformation.net



www.geoinformation.net



Thank you!

Questions?