Integrating ArcGIS desktop in data interoperability environments with heterogeneous GIS clients

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Stuttgart University of Applied Sciences

Stuttgart University of Applied Sciences

11 bachelor and
13 master programs

Photogrammetry and Geoinformatics and 3 more GIS related courses

GIS Laboratory with current focus on data interoperability

Host of an annual ESRI User Group Meeting in the State Baden-Württemberg

Content

Types of and reasons for data interoperability

Data interoperability based on common data stores

Experiences with ArcGIS 9.3.1 and other GIS in using ORACLE 9g as a common database

Data - Interoperability

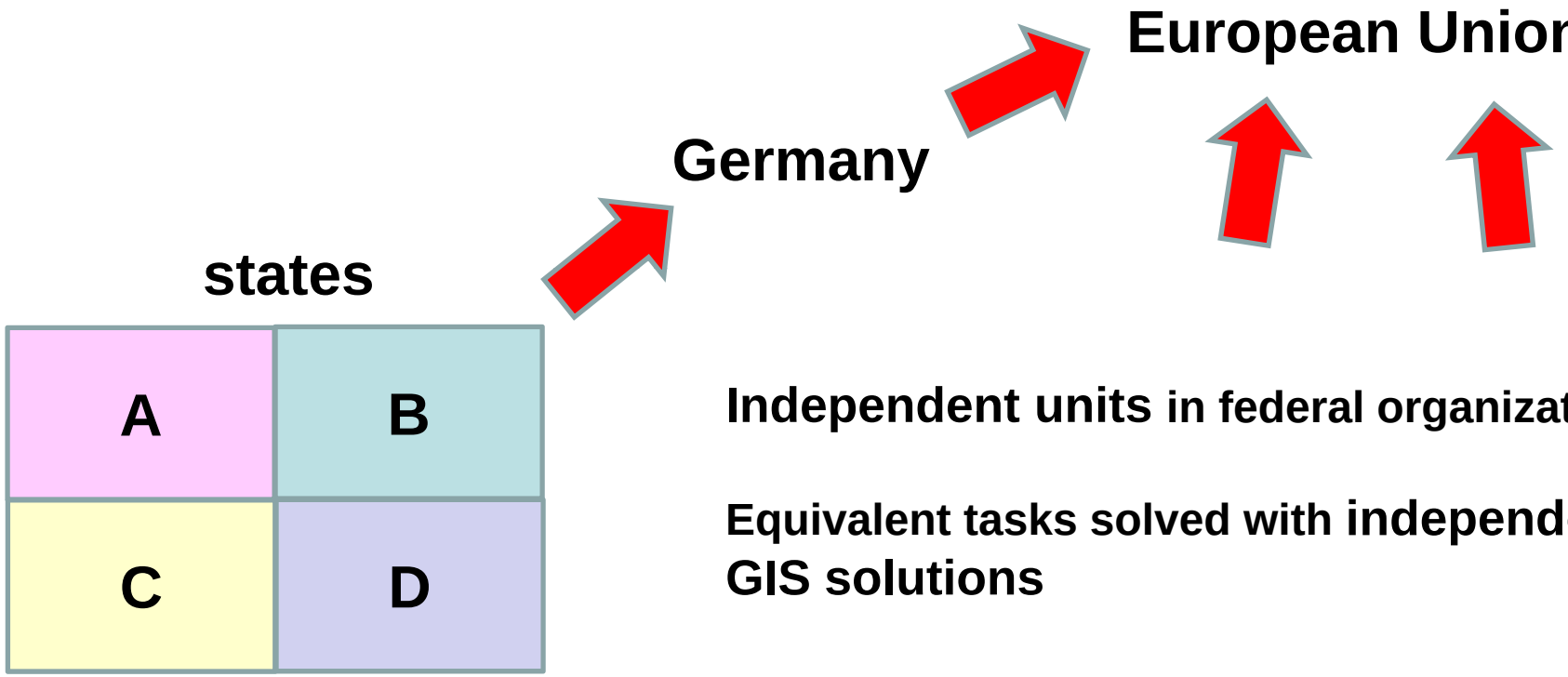
Data interoperability based on common (open) data formats in DBMS, e.g. Oracle SDO_Geometry

Data interoperability based on OGC Web Services,
Web Map Service (WMS) and
Web Feature Service (WFS)

Presentation
“Replacing Local Data by Web Services Using ArcGIS Desktop“,
Biniam Neguse, Wednesday Jul 14, 2010, 1:30 – 2:45, Room 28 D

Spatial Data Infrastructure (SDI) Scenarios

Regional separation – **interoperability in hierarchical structures**



Independent units in federal organizations

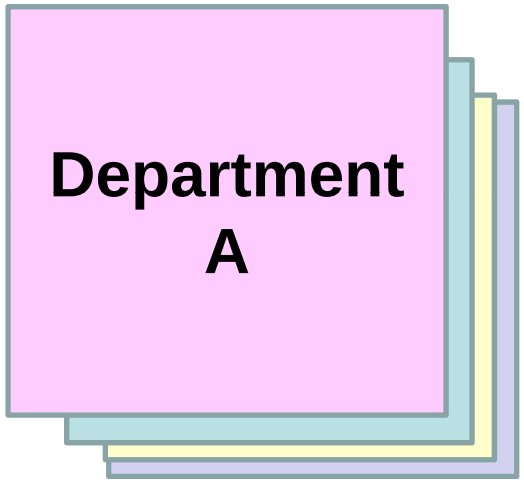
Equivalent tasks solved with independent GIS solutions

regions / counties / municipalities

Interoperability solution:
OGC Web Services
in a Wide Area Network

Spatial Data Infrastructure (SDI) Scenarios

Task based separation – **interoperability in coequal structures**



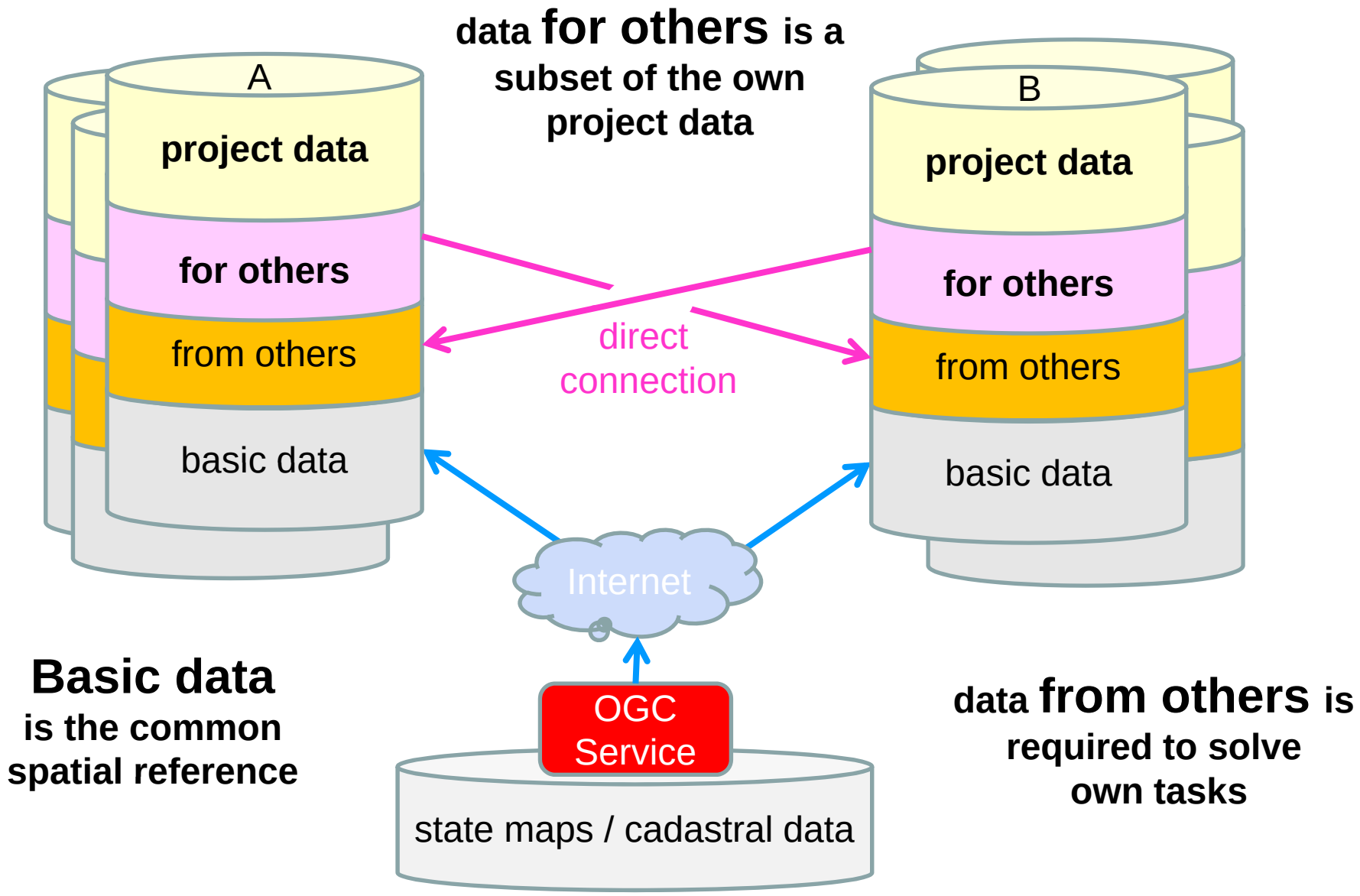
Independent organizations
ministries / departments

Individual tasks solved with
independent GIS solutions

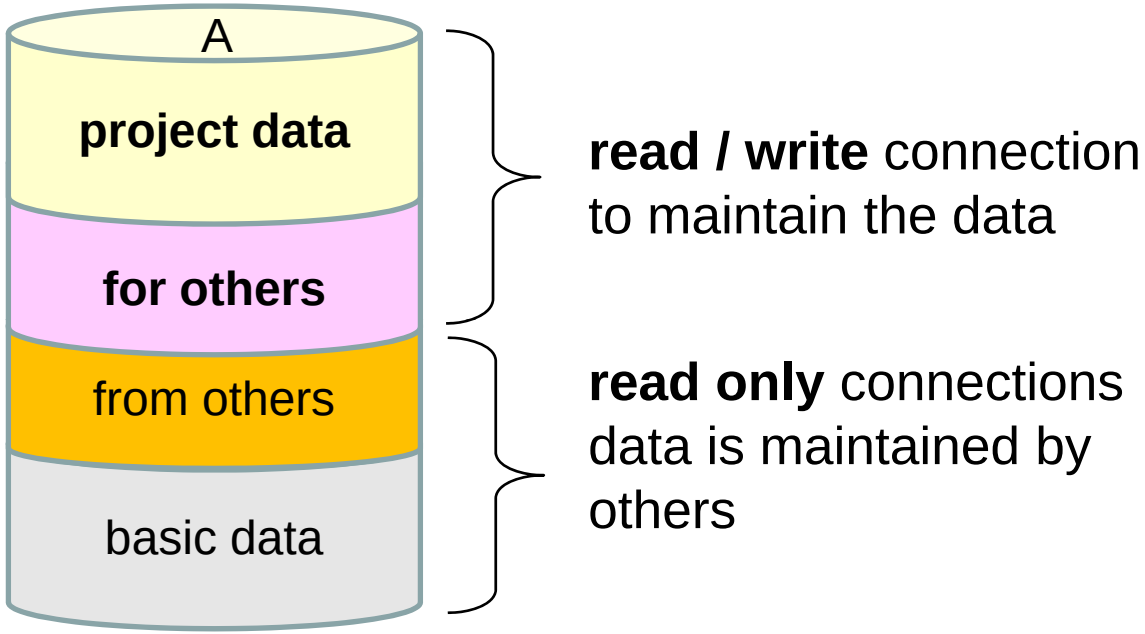
Same spatial
responsibility

Interoperability solution:
Common data store
in a Local Area Network

Data classification and connection types

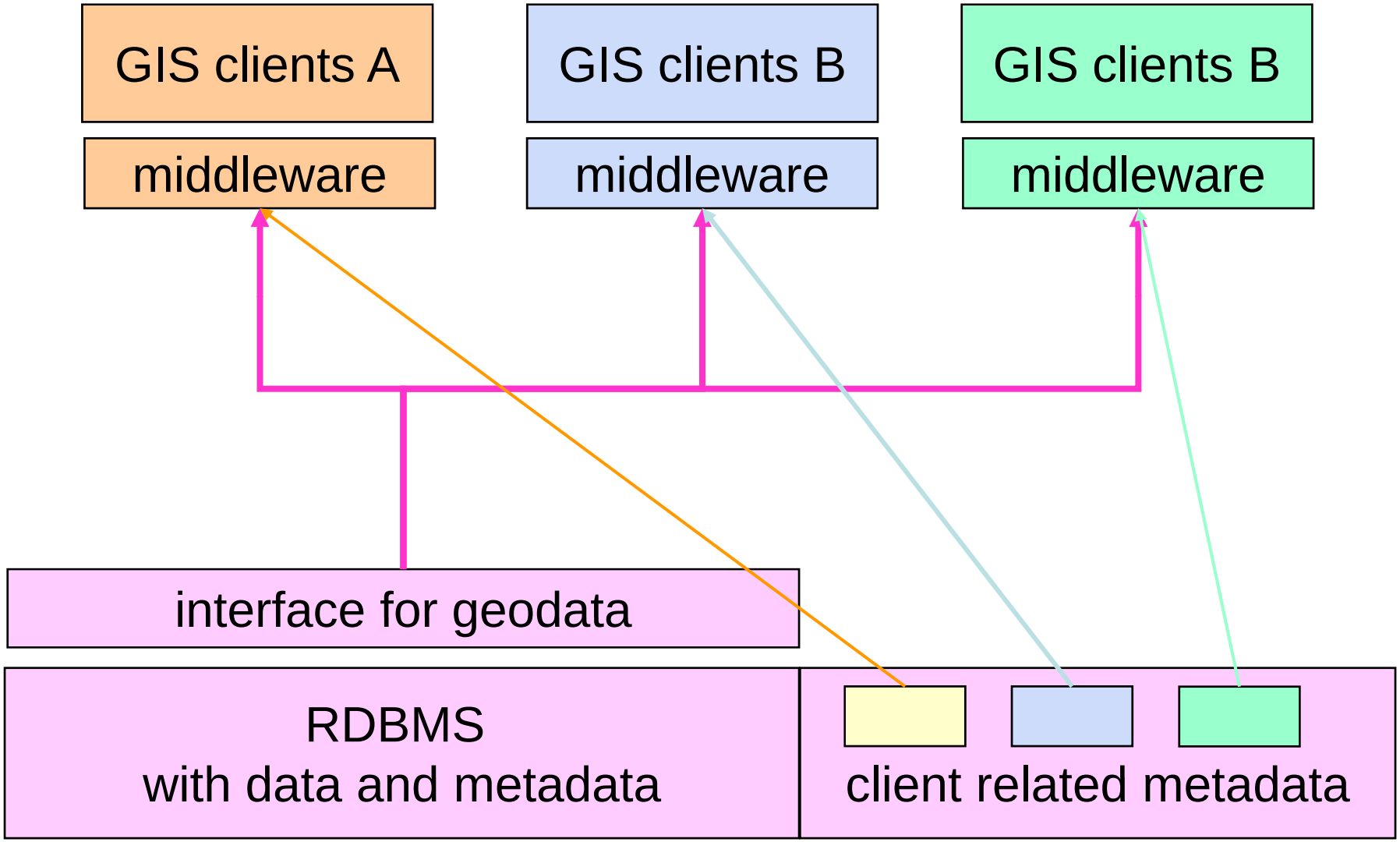


Data classification and connection types

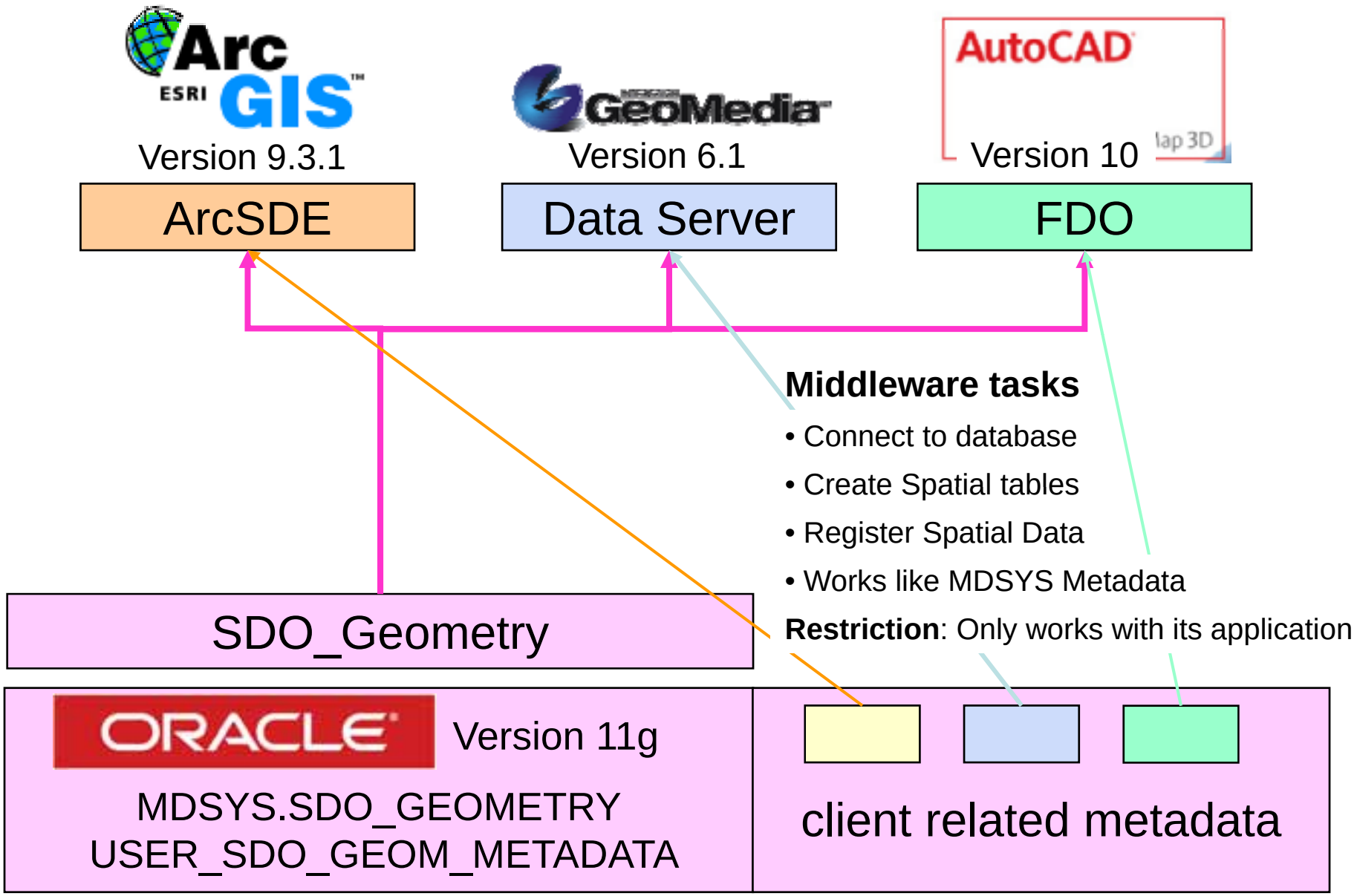


Usually there is no need to maintain (read / write) data with heterogeneous clients

Architecture in General



Architecture of the test environment



Data and Meta Data in ORACLE

Spatial Table

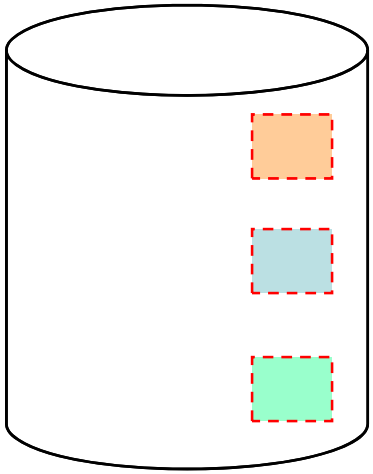
ID……Number
Attributes…. String, Integer, etc.
Geometry … SDO_GEOMETRY
with element info and
coordinates section

Oracle Metadata Table

- Table Name
- Geometry column Name
- Coordinate Reference System

Application Middleware Schema

- Table Name
- Geometry type
- Coordinate Reference System
- Owner of the table
- Geometry column name



Oracle Database

ArcGIS 9.3.1 offers
- auto registration to create its own meta data section for all data in the RDBMS.
- manual registration for selected Feature Classes

ArcGIS reads the information from the first feature

Interoperability Test

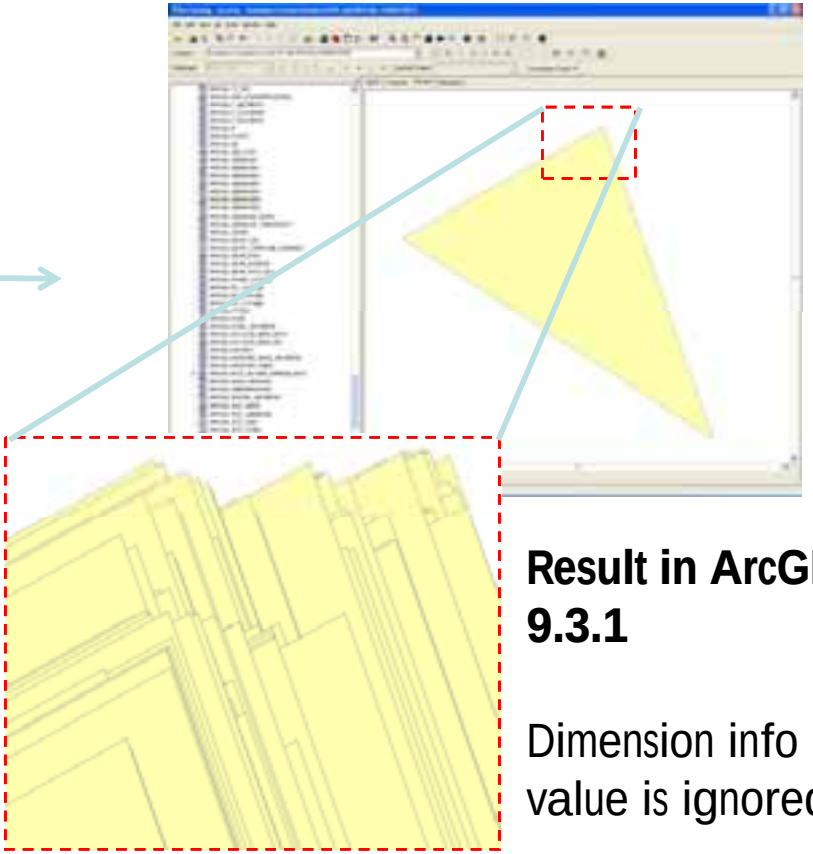
Created by \ Readable with	ArcGIS Desktop 9.3.1	GeoMedia Professional 6.1	AutoCAD Map 3D 2010	uDig 1.1.1
ArcGIS Desktop 9.3.1 (2D geometry only, no geometry collection)	Yes	Yes	Yes	Yes (Only Polygon, Line, and Point)
GeoMedia Professional 6.1 (3D geometry only, geometry collections)	No	Yes	Yes	Yes (Only Polygon, Line, and Point)
AutoCAD Map 3D 2010 (2D and 3D geometry, geometry collections)	Yes (2D only, no geometry collections)	Yes	Yes	Yes (Only Polygon, Line, and Point)
uDig 1.1.1	-	-	-	-

Limitation and Anomaly

Limitation with 3D data

GeoMedia Professional
Always stores spatial data
in 3D mode with z=0

Registered
with ArcSDE



Result in ArcGIS 9.3.1

Dimension info
value is ignored.

All data is read as 2D Geometry
So the original z=0 is interpreted as
X=0 or Y=0

Applicable solution

Workflow for read/write data interoperability

1. **Creating** all common feature classes **using ArcGIS**

2. Registering the Feature Classes with other systems

   here: AutoCAD, GeoMedia, and uDig

3. **Populate and modify** the existing feature classes with any system

   AutoCAD still allows to store multiple geometry types within all Feature Class. So it's users have to be careful.
   GeoMedia recognizes the geometry type set by ArcGIS and allows only to populate with features of this geometry type

Applicable solution

Results in using a common data base in read/write mode

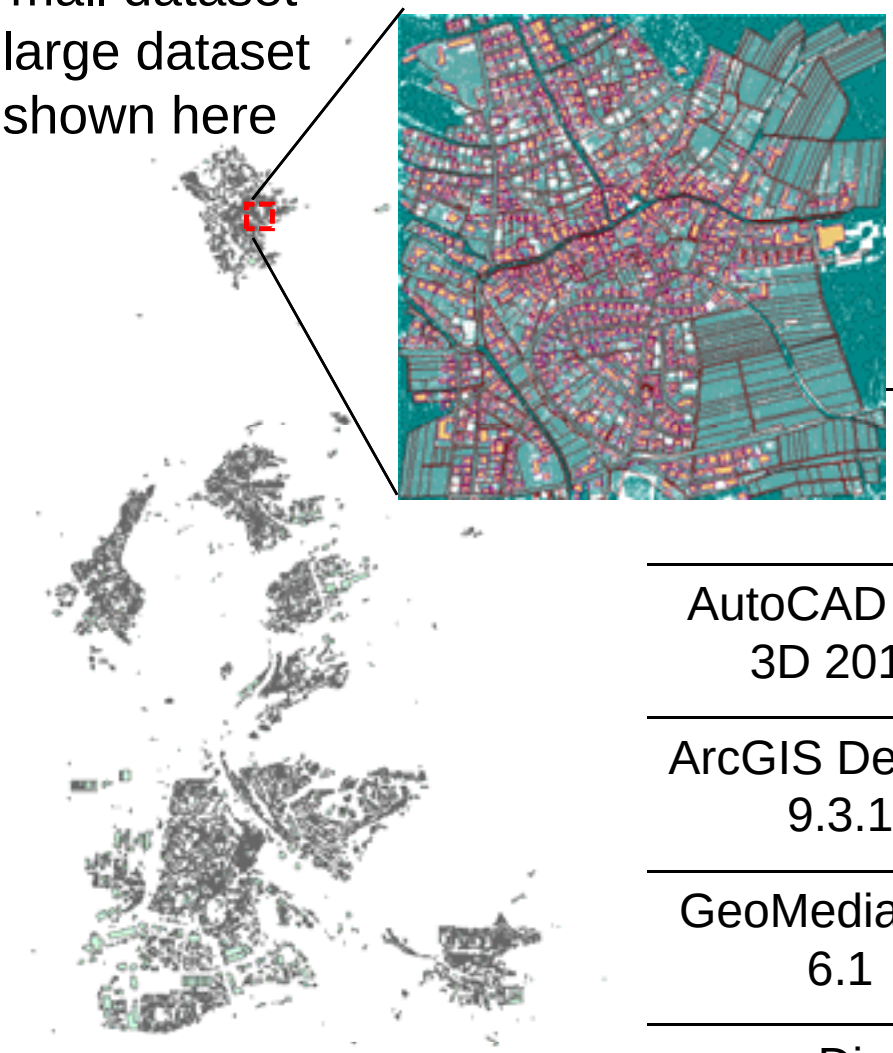
1. It is possible to maintain data in Oracle using multiple client software if all users take care of agreed geometry types and coordinate dimensions

2. Oracle always enables a mix of geometry types and coordinate dimensions in every feature class

3. Systems with restrictive own meta data like ArcGIS or GeoMedia ensure fixed geometry types in a feature class

Access tests with real world datasets

S = mall dataset
L = large dataset
shown here



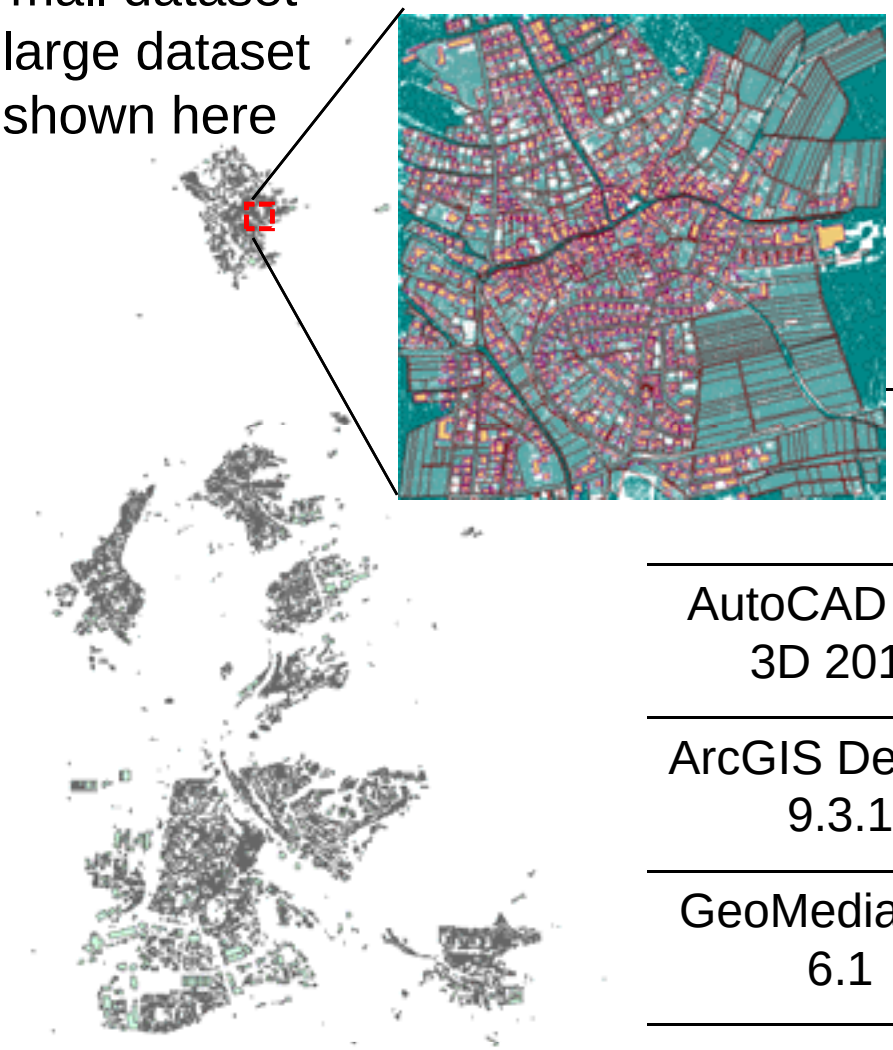
	Building polygons	First pulse lidar	Last pulse lidar
S	1 412	116 034	356 665
L	14 975	4 943 011	22 483 498

	Without Spatial Filter	
	Small dataset	Large Dataset
AutoCAD Map 3D 2010	4m 8s	Failed
ArcGIS Desktop 9.3.1	**1m 15s**	**24m 45s**
GeoMedia Pro. 6.1	1m 5s	Failed
uDig	2m 21s	Failed

Lidar data was used as point features to have large datasets

Access tests with real world datasets

S = mall dataset
L = large dataset
shown here



	Building polygons	First pulse lidar	Last pulse lidar
S	1 412	116 034	356 665
L	14 975	4 943 011	22 483 498

	With Spatial Filter 1*1 km²	
	Small dataset	Large Dataset
AutoCAD Map 3D 2010	2m 16s	4m 3s
ArcGIS Desktop 9.3.1	**14s**	**56s**
GeoMedia Pro. 6.1	30s	2m 36s

Lidar data was used as point features to have large datasets

Access tests with real world datasets

Data sets	Building polygons	First pulse lidar	Last pulse lidar
Small: 1 km² test data	1 412	116 034	356 665
Large: Municipality WN	14 975	4 943 011	22 483 498

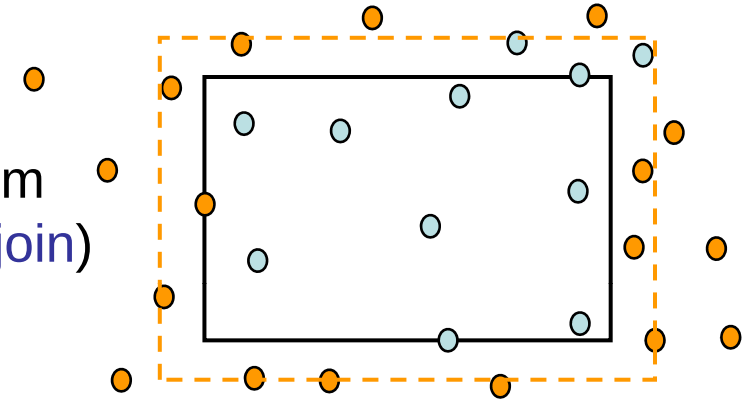
Lidar data was used as point features to have large datasets

	Without Spatial Filter		With Spatial Filter 1 * 1 km²	
	Small dataset	Large Dataset	Small Dataset	Large Dataset
AutoCAD Map 3D 2010	4m 8s	Failed	2m 16s	4m 3s
ArcGIS Desktop 9.3.1	1m 15s	24m 45s	14s	56s
GeoMedia Pro. 6.1	1m 5s	Failed	30s	2m 36s
uDig	2m 21s	Failed	-	-

Processing time on spatial data

The task: Calculate the height of the buildings using their footprints and lidar preclassified data (first pulse = on roof or vegetation, last pulse = on ground)

Top = mean of all first pulse points within a building (spatial join)
Ground = mean of all ground points within a 3 m buffer around each building (spatial join)
Height = Top - Ground



	ArcGIS 9.3.1	GeoMedia Pro-fessional v.6.1	AutoCAD Map 3d 2010	uDig v.1.1.1
Calculate build-ing height with large dataset	- 4 hours without intermediate table. - 14 minutes with intermediate table	15 minutes	50 minutes	-

Loaded data from large dataset

Buildings: 1 412 records, First Pulse 152 512 records, Last Pulse 342 304 records

The intermediate table applies spatial filtering before joining

Conclusions 1

+ **It is possible to share data by using Oracle's SDO_GEOMETRY based on OGC standards**

+ **Using a common database avoids copying data**

+ **Data is always up to date**

+ **The responsibility for all data is always by the owner**

Conclusions 2

- **Users have to agree to a common structure of the data (community structure)**
- **The common structure should be based on the possibilities of the system with most restrictions (e.g. ArcGIS)**
- **Avoid joins – necessary attributes should be stored together with the geometry to benefit from the spatial index**
- **Comparing the results with former ones shows, that al vendors are on a good way to support data interoperability**

+ **ArcGIS 10 will allow to read geometry data from standard RDBMS without ArcSDE**

Further research

1. **Extend the research to other RDBMS supporting spatial information**

2. **Testing the new GIS versions, especially ArcGIS10**

3. **Set up an environment for students to get experience with data sharing based on common data bases from various vendors**

Thank you for attending this presentation