Oracle Spatial User Conference

May 19, 2011
Ronald Reagan Building and International Trade Center
Washington, DC  USA
Moser Wolfgang
Senior GIS Architect

Roberto Orsi
Product Manager

Nicola Giuliani
Project Manager
newGIS

Persistent Topology based System to provide Cartographic Transactional Web Services at the Province of Bozen, Italy
**Agenda**

- **Overview**
  - History
  - Aims
  - Principles
  - Challenges
  - Results
  - Future

- **Core & topology**
  - The Story
  - The Project
  - achievements
    - The Basis
    - Locked Area
    - The Rules
    - Clone Simple Features

- **Clients & Web Services**
  - Types of Clients
  - Types of Web Services
    - Security
    - Meta information and data
    - External functionality
DEMONSTRATION

Overview
History

1990 1995 2000
ArcINFO Coverage ESRI ArcView Shapefile ArcGIS

ArcINFO Coverage ESRI ArcGIS

a few heavy applications
->   ->  strong increase in width

1990 2000 2004 2005
ArcINFO Coverage ESRI ArcGIS

2004 2009
ArcIMS WebGIS

centralization, publication, simple editing

2004 2009
ArcIMS WebGIS

increasing demands for complex solutions

2004 2009
ArcIMS WebGIS

what we want:
- quality RDBMS
- open interfaces
- GIS Infrastructure
- freedom to go our way

2004 2009
ArcIMS WebGIS

spatial data Infrastructure, open standards, newGIS
Aims

- Full use of all aspects of high-quality database for GIS;
- GIS should become a service and not an increasing number of applications;
- Definition and control of rules in the server;
- Expandable system and controlled maintenance costs;
- Low costs for simple “standard” applications;
- Uniqueness of the geometric relations and ability to query them directly;
- Open interfaces to any specialist tools (…);
- Joint management of the geometrical and the traditional attributes of objects;
- Independence of applications from data storage;
- Standardization of communication interfaces.
Principles
Challenges

• What does GIS expect from persistent topology?
• Who is able to understand our aims and to reach the targets?
• What are the technical difficulties and imperfections we will encounter?
• The simplicity of the smart data model had also several implications.
Challenges: Topology
Challenges: Topology

Rules
- within one layer,
- within one topological structure,
- within different topological structures.

- exactly or depending on tolerances?
- warranted by data model or by fat client?
Results

May 2011
Oracle Spatial User Conference

ORACLE SPATIAL 11g

MetaDB

Editing Server
  Service Manager
  Rules Manager
  SSO

WebServices (GML/XML)

WMS

gvSIG geneSIG

other clients
(new, free, licensed, legacy)
Results: Configurator
Results: Editing tool
**Results: Web Services**

**Oracle Spatial User Conference**

---

### Geoprocessing 1 ByID

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start</td>
<td>Geo</td>
<td>Contains</td>
<td>Contains</td>
<td>Contains</td>
<td>Contains</td>
<td>Contains</td>
</tr>
<tr>
<td></td>
<td>Contains</td>
<td>Contains</td>
<td>Contains</td>
<td>Contains</td>
<td>Contains</td>
<td>Contains</td>
</tr>
<tr>
<td></td>
<td>Crosses</td>
<td>Crosses</td>
<td>Crosses</td>
<td>Crosses</td>
<td>Crosses</td>
<td>Crosses</td>
</tr>
<tr>
<td></td>
<td>Disjoint</td>
<td>Disjoint</td>
<td>Disjoint</td>
<td>Disjoint</td>
<td>Disjoint</td>
<td>Disjoint</td>
</tr>
<tr>
<td></td>
<td>Equals</td>
<td>Equals</td>
<td>Equals</td>
<td>Equals</td>
<td>Equals</td>
<td>Equals</td>
</tr>
<tr>
<td></td>
<td>Overlaps</td>
<td>Overlaps</td>
<td>Overlaps</td>
<td>Overlaps</td>
<td>Overlaps</td>
<td>Overlaps</td>
</tr>
<tr>
<td></td>
<td>Touches</td>
<td>Touches</td>
<td>Touches</td>
<td>Touches</td>
<td>Touches</td>
<td>Touches</td>
</tr>
<tr>
<td></td>
<td>Within</td>
<td>Within</td>
<td>Within</td>
<td>Within</td>
<td>Within</td>
<td>Within</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LayerID</th>
<th>FeatureID</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>174941</td>
<td>406</td>
<td>WAHR</td>
</tr>
<tr>
<td>174941</td>
<td>406</td>
<td>WAHR</td>
</tr>
<tr>
<td>158356</td>
<td>406</td>
<td>WAHR</td>
</tr>
<tr>
<td>158419</td>
<td>406</td>
<td>WAHR</td>
</tr>
<tr>
<td>158419</td>
<td>406</td>
<td>WAHR</td>
</tr>
<tr>
<td>158356</td>
<td>406</td>
<td>WAHR</td>
</tr>
<tr>
<td>158419</td>
<td>406</td>
<td>WAHR</td>
</tr>
<tr>
<td>158419</td>
<td>406</td>
<td>WAHR</td>
</tr>
<tr>
<td>158356</td>
<td>406</td>
<td>WAHR</td>
</tr>
<tr>
<td>174941</td>
<td>406</td>
<td>WAHR</td>
</tr>
<tr>
<td>158356</td>
<td>406</td>
<td>WAHR</td>
</tr>
<tr>
<td>158419</td>
<td>406</td>
<td>WAHR</td>
</tr>
<tr>
<td>158419</td>
<td>406</td>
<td>WAHR</td>
</tr>
<tr>
<td>174941</td>
<td>406</td>
<td>WAHR</td>
</tr>
</tbody>
</table>

---

**Microsoft Excel - newGIS_FASE_V - Test 2011**

**Datei** | **Bearbeiten** | **Ansicht** | **Einfügen** | **Format** | **Extras** | **Daten** | **Fenster** |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Future

• Topological RDBMS and Application metadata
  – Improved performance;
  – Easier management (better configuration tool);
  – Higher responsibility for the database;

• newGIS
  – Migration of existing applications;
  – Publication (Data, Services, …) – INSPIRE directives;
  – Integration with our metadata infrastructure;
  – Clients with enhanced support of the topology;
  – Expansion of services and their orchestration.
DEMONSTRATION

Core Components & Topology
• **ABACO & ORACLE Topology:**
  - 2006: first approach with **ORACLE 10g topology**
    - prototyping a procedure for update data on the Persistent Topology Data Model
  - 2008/2009: topology was included in the ABACO strategic technology roadmap for keeping abreast of new developments based on **ORACLE (11.1.0.6 → 11.1.0.7)**:
    - 2010/2011: Implementing newGIS Core Components & Topology Loader with **ORACLE 11i**
• Started with **ORACLE 11.2.0.1**: 
• We found some bugs using PL/SQL and the Oracle Spatial JAVA API during the transposition in the topology: 
  • ORA-29532: Attempt to add an edge that ends in different faces 
  • ORA-xxxx: Other less frequent topology related errors… 
  • Fixed with the ORACLE patch n° **9571174 (September 2010)** 
• We found bugs during the test of the editing functions causing sliver faces, overlaps and holes: 
  • Fixed with the ORACLE patch n° **10633470 (February 2010)** for **ORACLE 11.2.0.2**;
achievements

- Base IT functionalities:
  - *Client server communications & DB Operations*
- Locked Area feature:
  - *Where the users works*
- The Rules engine:
  - *How different layers interacts*
- Clone Simple Features:
  - *The system used in a distributed environment*
newGIS Core Components & Topology Loader are based on Oracle Spatial Topology data model and API (TopoMAP):

- Standard Web Services for communications:
  - GML (for geometry transfers);
  - Standard compliance (tested on Java and DotNet);
- newGIS Core & Topology Loader are connected to Oracle DB through a JDBC connection;
- The operations on the database are performed through select, insert, update, delete statement and calling PL/SQL procedures;
- The whole Topology Data Model is managed through SDO_TOPO_GEOMETRY objects and SDO_TOPO_MAP package;
  - [http://download.oracle.com/docs/cd/E11882_01/appdev.112/e11831/toc.htm](http://download.oracle.com/docs/cd/E11882_01/appdev.112/e11831/toc.htm)
- Everything, related to the Simple Feature is managed through SDO_GEOMETRY objects and SDO_GEOM and SDO_UTIL packages;
  - [http://download.oracle.com/docs/cd/E11882_01/appdev.112/e11830/toc.htm](http://download.oracle.com/docs/cd/E11882_01/appdev.112/e11830/toc.htm)
locked area defines the area where a user is working. All the objects fully included can be modified by that user;
all the objects that intersect the locked area, can be modified only for the part inside the lock area.
the server recognizes changes to objects intersecting the area, but external from the locked area, to discard them.
Configurable Rules Engine

- Two types of rules:
  - **Blocking rules**: the user cannot ever violate the rule;
  - **NON-Blocking rules**: the user can decide if the rule can be violated;

- The server can enforce rules as:
  - **direct**: the rule is always enforced by the system (from A to B);
  - **NON-direct**: the violation is only reported to the user in case of a previous consistent state has been violated (from B to A);
Predefined Rules

Visualizzazione Regole Topologiche e Tipi Regole

<table>
<thead>
<tr>
<th>Codice Tipo</th>
<th>Nome Tipo</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>LineCoversLineTotally</td>
</tr>
<tr>
<td>6</td>
<td>LineCoversPolygonTotally</td>
</tr>
<tr>
<td>7</td>
<td>LineDisjoint</td>
</tr>
<tr>
<td>9</td>
<td>PointCoversLine</td>
</tr>
<tr>
<td>10</td>
<td>PointInPolygon</td>
</tr>
<tr>
<td>2</td>
<td>PolygonCoveredByPolygon</td>
</tr>
<tr>
<td>1</td>
<td>PolygonCoveredByPolygons</td>
</tr>
</tbody>
</table>

Regole Topologiche

<table>
<thead>
<tr>
<th>Tipo Regola</th>
<th>Sorgente</th>
<th>Destinazione</th>
</tr>
</thead>
<tbody>
<tr>
<td>PointInPolygon</td>
<td>NG_TF_LAST_COL_EP</td>
<td>NG_TF_LAST_COL_AS</td>
</tr>
</tbody>
</table>
Predefined Rules

Rules within layers:

- Holes
  - 1
  - 2
  - 3
  - 4

- Overlap
  - 1
  - 2

Rules between layers:

- Dots (red)
- Topology layers:
  - Polygons (blue)
- New objects
  - Points & polygons (black)
Single Layer Rules

- holes not allowed
- overlap not allowed

*(these are always blocking rules)*
i.e. (Point in Polygon from A to B)

- Layer A: point
- Layer B: polygon
- Defined rule:
  - Point in Polygon from A to B
    - defined as blocking rule from A to B
    - defined as NON-blocking rule from B to A

 topology layers:
  - Points (red)
  - Polygons (blue)

 New objects
  - points & polygons (black)
### Topology Layers:
- Points (red)
- Polygons (blue)

### New Objects
- Points & Polygons (black)

<table>
<thead>
<tr>
<th>Operation</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delete of object 1</td>
<td>The user is asked for a confirmation of deleting cause of NON-blocking rule violated</td>
</tr>
<tr>
<td>Delete of object 2</td>
<td>The polygon is deleted without any request to the user (no changes to a previous consistent situation)</td>
</tr>
<tr>
<td>Delete of object 4</td>
<td>The operation is not possible cause of DIRECT BLOCKING RULE</td>
</tr>
<tr>
<td>Drawing of polygon 5</td>
<td>The operation is allowed without any request cause the new polygon doesn’t make any changes to a previous consistent situation</td>
</tr>
<tr>
<td>Drawing of point 6</td>
<td>The operation is not allowed cause of violation of DIRECT BLOCKING RULE</td>
</tr>
</tbody>
</table>
Clone simple feature to another remote DB

Oracle Spatial (11.2.0.2)

NG_TF_TOPO1_TAB1

<table>
<thead>
<tr>
<th>ID</th>
<th>FEATURE</th>
<th>SIMPLEFEATURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sequence number</td>
<td>as SDO_TOPO_GEOMETRY</td>
<td>as SDO_GEOMETRY</td>
</tr>
</tbody>
</table>

newGIS Core

Client geneSIG

Oracle DB's

The SDO_GEOMETRY is inserted/updated/deleted to configured database where a copy of the simple feature is necessary. If the operation is not done for different reason, the newGIS database store the history of this operations to know how to re-align the situation on the remote database.
Demonstration

Clients & Web Services
The Story

• The Trilogis & newGIS:
  • 2006: first approach to feasibility study, in collaboration with the customer;
    • First approach to Oracle Spatial 10g
  • 2007: complete analysis of the feasibility study
    • Definition of macro areas
    • Risk Analysis
    • Estimate of the time and costs
  • 2008/2009: detailed analysis of data management detail section, in collaboration with Abaco and the Customer
  • 2009/2010: implementation of the newGIS web services and the geneSIG Client
    • Project Management & document integration
The Project

- The implementation project starts in February 2010;
- OBS (Organization Breakdown Structure) definition;
- Team definition (9 people on the Supplier side, 5 people on the Customer side);
- Definition of Roles and Responsibilities (RAM - Responsibility Assignment Matrix);
- Definition of rules of cooperation among suppliers;
- Management and integration of project documentation;
- Monitoring of Milestones and of Project progress;
- Design, analysis and implementation of the client;
- Final acceptance of the project is scheduled for June 2011.
Clients

Data Repository support

Features & topology

Layout, ...

XML DATA/GML

Middleware Level

Integration Level (WS)

NewGIS Core

Application server

Oracle Spatial 11g R2

+ Oracle 10-11

WMS Server

MS Active Directory

other clients
(new, free, licensed, legacy)
Type of clients

✓ The clients have to be designed according to the user needs;
✓ in some cases there may be the need of a CAD client;
✓ in some other of a high level GIS client;
✓ and sometimes only of a light web client.
The intelligence of the client for a specific project depends on the requested level of automation, on the complexity of the needs.
Types of web services

- WS – Of Security
- WS – Meta Information
- WS – External Functionality

Integration adapting newGIS Core
Main goal of web services:

- To provide a simple way to authenticate users
- To define an abstraction level that will be helpful for integrating newGIS system with Single Sign On and other systems
WS - Meta-Info and Spatial Data

- Informations about projects and work-spaces (layers, rules, background, ...);
- Basic information about the rendering of layers in Table of Content;
- Transmission of data in both directions (geometry becomes a simple feature);
- Lock Area;
- ....
WS - External Functionality

- Provide spatial functions like:
  - union
  - intersect
  - equals
  - ...

- Provide a way to execute Oracle’s spatial query or, in general, an entry point on Oracle Topology.
Special thanks to

Giovanni Corcione – ORACLE Italia
Siva Ravada – ORACLE USA

Alessandra Avvenuti
Fulvia Gambalonga
Marco Iellici
Helmuth Leitner
Alessio Modena
Francesco Peloso
Tommaso Nolli
Peter Zanetti
Fabio Tombolesi
Martin Zambaldi
How to contacts us:

wolfgang.moser@provinz.bz.it

r.orsi@abacogroup.eu

trilogis  
nicola.giuliani@trilogis.it