AXIS GIS
Interactive visualization of detailed and aggregated exposure data

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Agenda

- AXIS Capital
- Very short introduction to CAT modeling
- Motivation for a GIS application at AXIS
- Presentation of AXIS GIS
- Architecture and design reasons of AXIS GIS
Axis Capital at a Glance

- Founded 2001 post 9/11
- Total capitalisation of USD 6.6bn; Shareholder’s equity of USD 5.6bn (as of 31 December 2010)
- A team of more than 900 professionals across locations in Europe, Bermuda, the US, Canada, Australia and Singapore
- Split into three segments: Axis Insurance, Axis Reinsurance, Axis Global Accident & Health
- Group CEO John R Charman and Group Chairman Michael A Butt
- www.axiscapital.com
Gross Premium Written at Year End 2010 (End 2009)

AXIS Capital Consolidated GWP = USD 3’751m (USD 3’587m)

AXIS Re GPW = USD 1’834m (USD 1’812m)

Insurance 53% (49%)
Reinsurance 47% (51%)

Credit & Bond 14%
Professional Lines 16%
Liability 13%
Engineering 4%
Motor 8%
Other 2%
Catastrophe 24%
Property 19%
The Concept of Reinsurance

Distinction Insurance – Reinsurance

Insurance
Is a risk transfer mechanism that ensures financial compensation for a loss caused by events beyond the control of the insured.

Reinsurance
Is a practice where an insurance company transfers a portion of its risks to another (the reinsurer). The reinsurer insures insurances.

Reinsurance has no influence on the relationship of the insured and the insurance company.
Risk analysis of property treaties covering natural hazards using stochastic models of natural hazards

CAT models usually consist of 4 modules:
- Hazard
- Vulnerability
- Distribution of Insured Objects
- Financial module

Modeling involves use of historic events and creation of stochastic event loss tables (frequency, severity, losses)

Modeling Result: loss distribution for a treaty
Catastrophe Modeling Process

Goal: calculation of a loss distribution and the expected loss for the duration (usually 1 year) of a treaty

Instruments: stochastic CAT modeling software providing models for certain perils and countries.

Additional utilities: Pricing tools, GIS, actuarial tools

- Validation of exposure data (input data)
- Validation of modeling results
- Risk analysis of perils/countries that are not covered by the risk modeling software
**Exposure: all insured objects (properties) covered by the treaty**
- Detailed exposure: single risks (e.g. houses), geocoded on street address level
- Aggregated exposure: risk information is available as spatial aggregates

**Typical spatial exposure units**
- CRESTA zones (consist of administrative zones like provinces, cantons, regions)
- USA: counties / zip code zones

**Exposure analysis:**
- Spatial exposure distribution
- Comparison to last years exposure
Benefits of GIS in the Reinsurance context

- Visual exposure overview
  - Risk clustering in hazard zones
  - Filtering of property type
- Visual comparison of exposure change over the years
- Identification of “Bulk-Geocoding”
- Visual control of the modeled expected loss
- Visualization of hazard events
- Damage analysis
Axis GIS: Requirements

- An application to automatically visualize spatial treaty data on button click
- No GIS knowledge required
- Interactive data visualization
- Several map reports for exposure analysis
  - Location Report (detailed exposure, visualize single objects)
  - Aggregated exposure (CRESTA polygons, single objects are aggregated to an administrative unit)
  - Exposure comparison reports (e.g. exposure comparison with the corresponding treaty of the last year)
- Provide hazard map service overlays (geoRss, WMS)
Axis GIS: Existing infrastructure

- Treaty data is stored in SQL server databases
- One (or many) databases per treaty
- Spatial data of ~1000 databases must be visualizable

Challenges:
- DB servers in Boston
- Users in Zürich, New York, Bermuda
- Treaty can consist of up to $10^6$ locations to be visualized

Data to be visualized is unknown until runtime
Axis GIS Architecture

User interface:
- Silverlight 4
- ESRI Silverlight API

Integration:
- Queries databases
- Calls stored procedures
- Links business data with spatial data
- Creates result tables

ESRI MapIt:
- Provides Spatial Data Service (SDS) with REST endpoint
- Streams SQL server spatial types or lat/long data as JSON objects
1. Enter a ProgramID (treaty identifier)
2. Set report parameters
3. Data is selected and transformed in SQL server
4. MapIt sends data back to client
Axis GIS: History Report (aggregated exposure)

- Rendering of aggregated exposure data (total insured value or #locations)
- Compares this year’s exposure with last year’s exposure (percent change)
- Classbreak renderer
- Map features are linked with the feature data grid
Axis GIS: Current/Normalized Exposure (aggregated)

Map showing a treaty’s total insured values per county

Normalized values (insured values divided by county area)

- Rendering of aggregated exposure data
- continuous unique value renderer (color interpolation)
- Normalized view: ~ exposure density
The screenshots show the same data in different zoom levels. The single point geometries are aggregated/exploded according to the zoom level.

- Overview Map
  - Exposure extent (yellow)
  - Currently visible extent (red)

- Silverlight cluster renderer: Efficient way to visualize lots of point data
Axis GIS: Print tool

- Renders map content, legend and Metadata in an A4 sized layout
- The Print preview consists of a second map control. Graphic features are cloned from the main map control and are displayed in the print preview map control (in order to avoid a second server call)
- Print layout can be filed as .png or sent to the print spooler
High value risks (construction sites, factories..) need buffer zones
Map tip on mouse hover
AGS and MapIt provide the same endpoints, both can be consumed with Silverlight API

MapIt was chosen because of 1 specific requirement
## Axis GIS: Comparison MapIt - AGS

<table>
<thead>
<tr>
<th>Criteria</th>
<th>MapIt</th>
<th>AGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamic access to all databases of an SQL server</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>SQL server spatial support</td>
<td>Yes (Spatial Data Service)</td>
<td>Yes (Query Layer)</td>
</tr>
<tr>
<td>Feature data server</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Map server</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Support Of ESRI Web API’S</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Geoprocessing</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Extendable (ArcObjects)</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Blackbox</td>
<td>Yes</td>
<td>Extensively Documented</td>
</tr>
<tr>
<td>Server – Client Rendering</td>
<td>Data delivery on the server, all rendering needs to happen on the client</td>
<td>Rendering can happen on server or on client</td>
</tr>
<tr>
<td>Support</td>
<td>Almost inexistent</td>
<td>Good</td>
</tr>
<tr>
<td>Handling</td>
<td>Easy</td>
<td>Demanding</td>
</tr>
</tbody>
</table>
ESRI MapIt

- MapIt provides REST endpoints to all databases/tables of a SQL server
- REST URL can be consumed by a ESRI web API library

ArcGIS Server:

- Each data source needs to be set up in a map service definition. Dynamic connection to a resource which is unknown until runtime is not possible with a mapservice
- Theoretically a Server Object Extension (SOE) can change a service data source on runtime but the service is instable after the service state has been changed.

In the long run, AGS would be the better solution because of its larger functionality. But since a dynamic connect / change of data sources within AGS services is not possible, AGS is not an option for us.
Thank you very much for your attention.