Stir It Up: Achieving GIS Interoperability

City of Tacoma, Washington, USA

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Stir It Up - Achieving GIS Interoperability (Abstract)

Achieving GIS interoperability between diverse systems can be accomplished with ArcSDE, Oracle, and a few tricks.

GIS at the City of Tacoma Washington uses a mix of desktop tools (ESRI ArcGIS, Autodesk Map, and GE Energy’s Smallworld), data types (some readable to only one desktop tool), web tools (ESRI ArcIMS and Autodesk MapGuide), and numerous staff dispersed throughout several departments.

High quality work is achieved with this mix, but challenges do exist. Lack of an enterprise database appears to be the most limiting factor. Recent use of Oracle has illustrated the potential for interoperability among users via Oracle’s spatial capabilities. By using a common database and a few maintenance tricks, productivity can increase. Individual users can keep their favorite tools while all can access the same data.

This paper will discuss technical procedures, successes, and future direction.
Abstract

GIS at Tacoma:
1. Numerous GIS tools
2. Numerous staff in several departments
3. Numerous data types

Limiting Factor: No enterprise database

Solution: A spatial database (Oracle Locator)

Discussion: Procedures, successes, future
Current Conditions

1. Numerous GIS tools:
   - ESRI ArcGIS 9.1 – Planning
   - ESRI ArcIMS 9.1 – Planning (Internet)
   - Autodesk Map 3D 2006 – Engineering
   - Autodesk MapGuide 6.3 – Engineering (Internet)
   - GE Smallworld 3.3 – Utilities
   - Oracle Locater 10g R2 – SQL spatial queries
   - Microsoft Access 2003 – Attribute updates

2. Numerous staff in several departments:
   Decentralized with ~50 staff in seven departments

3. Numerous data types:
   Some readable to only one GIS tool

Suitable for a wide range of GIS users, but ...
Can interoperability be achieved?
GIS Interoperability
(Definition per City of Tacoma Public Works Department)

1. Data Centric:
   Organized real-time geographic information

2. No Barriers:
   Accessible to GIS tools, databases, and web

3. Functional and Easy:
   No extra effort for technical/casual end-user
Native access to spatial data advantages:

1. No conversion
2. No data loss
3. No data copies
4. No stale data
GIS Interoperability
Oracle Geometry Type

- **SDO_Geometry:**
  New data type, OGC-compliant

- **Allows SQL geoprocessing:**
  Intersect, buffer, etc

- **ArcGIS 9.2:**
  Access, create, update, and delete data via standard SQL to the ESRI Spatial Type for Oracle
Geometry Type ≠ Interoperability

There is a common misconception that applications can interoperate simply because they support the same underlying geometry type.

The geometry type is only one aspect of the interoperability picture –

a common understanding of rules, constraints, schema, and implementation is also required.
## Interoperability Constraints

<table>
<thead>
<tr>
<th></th>
<th>Autodesk</th>
<th>GE</th>
<th>ESRI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Geometry Columns</strong></td>
<td>Multiple</td>
<td>Multiple or Single</td>
<td>Single</td>
</tr>
<tr>
<td><strong>Coordinates</strong></td>
<td>x, y, z</td>
<td>x, y</td>
<td>x, y</td>
</tr>
<tr>
<td><strong>Connector</strong></td>
<td>Built In</td>
<td>InSync</td>
<td>ArcSDE</td>
</tr>
<tr>
<td><strong>Metadata Tables</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td>ADMP columns</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
Solution to Constraints

- One “master” GIS tool per theme
- Oracle triggers “mirroring” the data
- One way synchronization
## Triggers Depend on Creator

<table>
<thead>
<tr>
<th>Creates Data</th>
<th>No Trigger Needed</th>
<th>Trigger Needed</th>
</tr>
</thead>
<tbody>
<tr>
<td>ArcGIS</td>
<td>MapGuide, Smallworld</td>
<td>Map 3D</td>
</tr>
<tr>
<td>Smallworld</td>
<td>MapGuide, ArcGIS ¹</td>
<td>Map 3D, ArcGIS ¹, ²</td>
</tr>
<tr>
<td>Map 3D</td>
<td>MapGuide, Smallworld</td>
<td>ArcGIS ²</td>
</tr>
<tr>
<td>MapGuide ³</td>
<td>Map 3D, Smallworld, ArcGIS</td>
<td>N/A</td>
</tr>
</tbody>
</table>

¹ Trigger needed if multiple geometry columns exist
² An SDE View may be used instead of a trigger
³ Data created through SQL commands to a web service
Technical Procedures - ESRI

Step 1 – Export to Feature Class
Technical Procedures - ESRI

Step 2 – Set Oracle keyword

![Environment Settings](image_url)

- Output CONFIG Keyword: 
  - `$DO_GEOMETRY`
- Output Spatial Grid 1: 0
- Output Spatial Grid 2: 0
- Output Spatial Grid 3: 0
- Output XY Domain: Same as Input

OK button highlighted in red

Details:
- The configuration keyword specifies the default storage parameters (configuration) for geodatabases in an RDBMS (Relational Database Management System). This setting is applicable only when using ArcSDE.
Step 3 - Edit Data

1. Register as Versioned
   (SDE “copy”)

2. Edit
   (Area - ESRI Technical Article ID: 27329)

3. Compress Database
   (SDE “mirror”)

Technical Procedures - ESRI
Technical Procedures - GE

Step 1 - Connect
Technical Procedures - GE

Step 2 – Select tables to replicate
Technical Procedures - GE

Step 3 – Create data

![Diagram showing data creation process]
Technical Procedures - AutoDesk

Export (write) to Oracle

[Image of the Export Autodesk Map Objects to Oracle Schema dialog box]
Technical Procedures - AutoDesk

Import (read) Oracle Data
Native access to spatial data:

1. No conversion
   \( \ldots \textit{after the conversion or initial migration} \)

2. No data loss
   \( \ldots \textit{just hidden} \)

3. No data copies
   \( \ldots \textit{triggers instead} \)

4. No stale data
   \( \ldots \textit{unless there’s no time for maintenance} \)
Successes

- Building a city-wide GIS database
- Seeing all data despite creation tools
- Users can keep their tools
- Immediate updates
- Time savings
- Web geoprocessing with SQL
  (Critical Areas, Zoning example)
govME – government Made Easy

www.govME.org/Map
Parcel Summary – SQL Intersect
**Parcel Summary – SQL Intersect**

**Habitat Zone Percent:**

<table>
<thead>
<tr>
<th>PARCEL SUMMARY</th>
<th>Jun 20, 2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>--- Parcel 6135000266 ---</td>
<td></td>
</tr>
<tr>
<td>Address (in SAP): 3001 S Mullen St</td>
<td></td>
</tr>
<tr>
<td>Critical Area - Aquifer Recharge: 0.00% Parcel Coverage</td>
<td></td>
</tr>
<tr>
<td>Critical Area - Geotechnical Reports: 0.00% Parcel Coverage</td>
<td></td>
</tr>
<tr>
<td><strong>Critical Area - Habitat Zone: 36.24% Parcel Coverage</strong></td>
<td></td>
</tr>
<tr>
<td>Critical Area - Slope Stability: 0.00% Parcel Coverage</td>
<td></td>
</tr>
<tr>
<td>Critical Area - Volcanic Hazard: 0.00% Parcel Coverage</td>
<td></td>
</tr>
<tr>
<td>Critical Area - Wetlands: 36.42% Parcel Coverage</td>
<td></td>
</tr>
<tr>
<td>Inspector-Bldg. Rich McDonald, 253-591-5026</td>
<td></td>
</tr>
<tr>
<td>Inspector-Cnst: Mike Fears, 253-377-2374</td>
<td></td>
</tr>
<tr>
<td>Legal Documents: Easement E-2089</td>
<td></td>
</tr>
<tr>
<td>Legal Documents: Easement E-3169</td>
<td></td>
</tr>
<tr>
<td>Legal Documents: Easement E-3180</td>
<td></td>
</tr>
<tr>
<td>Legal Documents: Easement E-3341</td>
<td></td>
</tr>
<tr>
<td>Legal Documents: Vacation V-21266</td>
<td></td>
</tr>
<tr>
<td>Legal Documents: Vacation V-26442</td>
<td></td>
</tr>
</tbody>
</table>
Parcel Summary – SQL Intersect

Zoning Occurrence:

Legal Documents: Vacation V-26442
Parcel Area: 3.30 acres
Parcel Area: 143,748 sq ft
Solid Waste Call-2-Haul: Tuesday
Solid Waste Collection Route: Fri-Fb4
Solid Waste Garbage Pick Up: Friday Jun 23, 2006
Solid Waste Recycling Pick Up: Friday Jun 30, 2006
Solid Waste Supervisor: CG
Tax Assessed Impro Value (2006 Tax Year): $20,300
Tax Assessed Land Value (2006 Tax Year): $274,300
Tax Assessed Total Value (2006 Tax Year): $294,600
Taxpayer: Touchstone Mullen Street I Llc
Wind Zone: 90 mph (Ktz 1.12)
Wind Zone: 120 mph (Ktz 2.00)
Zoning: C2 - Commercial
Zoning: R2 - One Family Dwelling
Zip Code: Tacoma 98409
Future

- GIS Users Group
- Change procedures with software updates
- Eliminate triggers whenever possible
- Cost Sharing Agreement
- Policies for sharing, editing, & metadata
- Continue to explore options for user needs
Questions?

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