Oracle Spatial Summit

2015

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Oracle Business Intelligence Warehousing and Analytics Summit

Oracle HQ Conference Center
Redwood City, California

Effectively Integrate Geospatial Technologies from GIS to Oracle Spatial in Real Estate Sector

Francisco Javier Rojas Duran, IT Project Manager Professional
DASOFT

DASOFT
RUV (Housing Registry Authority) - SACP

OVERVIEW

- Customer : RUV (Housing Registry Authority)
- The Only Housing Registry Authority in Mexico, Supports around 350 Real Estate Companies.
- Storing all the geospatial data related to dwellings subject of subsidization and data related to Important Points of Interest (Schools, Markets, Recreational Areas, etc.)

CHALLENGES / OPPORTUNITIES

- Need for speed-up the process of Delivery, Reception and Qualification of the Housing Base Maps sent by the Real Estate companies using Autodesk Technology.
- Need to perform spatial calculation of distance between houses and particular point of interest.
- Need to display the houses into a Map.

SOLUTIONS

- Oracle Database 11g Enterprise Edition
  - Spatial Option
- Autodesk Infrastructure Map Server 2014
- AutoCAD Map 3D 2012-2014.
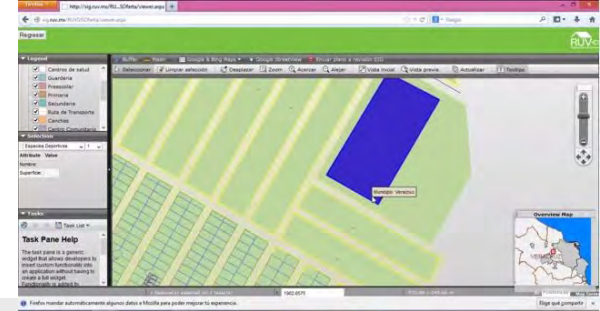
RESULTS

- Operation switched from a manual procedure by Geospatial Operators to automatized spatial queries and distances calculations.
- Achieved 10% performance improvement and lower query's elapsed time vs semi-manual process.
  - From 20 minutes per Map (From 1 up to 1000 houses) with the aid of GIS to 5 seconds per House. (House based performance) using Oracle DB. 218 =18 minutes.
- Less Human Resources needed for operation, some of them were promoted to Geospatial Analyst position.
- Longer service time (24x7) instead of (8x5).
- Consolidation of vector data in a central repository.
- Geospatial data store enabled for Business Intelligence.

Speaker Bio

- Francisco Javier is a Computer Science Engineer with a Master Degree in IT Management based on ITIL/ITSM

- He has proved experience in Geographic Information Systems for 10 years. He has been working either with Autodesk & Oracle Technologies. He has been trained in Oracle Spatial Technology, PL/SQL, SQL and DBA fundamentals.

- He has worked on Real Estate projects including the integration between Property Manager and Autodesk software. Currently he is working on spatial analysis performed by Oracle Spatial from data exchange performed by Autodesk technology, using Autodesk technology to display data into a map.

- He has been speaker in Autodesk University Extension in Mexico City.

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Agenda

- 1) Customer Bio and the Business Requirement, Project Scope and Main Objectives.
- 2) Best Practices for Importing GIS Data from Autodesk Technology to Oracle Spatial.
- 3) Performing Spatial Analysis with PL/SQL.
- 4) Tips & Tricks.

Objectives

- To describe the project and business case.
- To show how spatial data Integration was done.
- To show which issues came out regarding spatial analysis.
- To point out some tips regarding Spatial Operators Performance.

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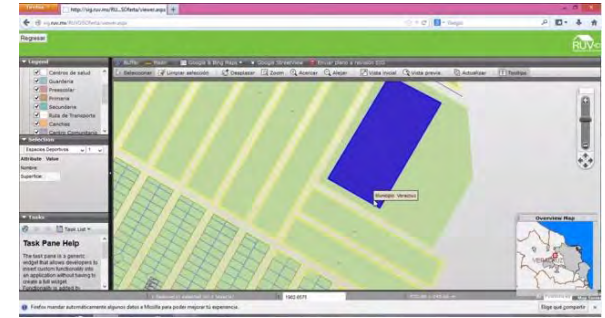
CHALLENGES / OPPORTUNITIES

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- Need to display the houses into a Map.

TECHNOLOGY COMPONENTS

- Oracle Database 11g Enterprise Edition
  - Spatial Option (11.2.0.4)
- Autodesk Infrastructure Map Server 2014
- AutoCAD Map 3D 2012-2014.
- Virtualized Environment.

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Project Scope

- To develop a web-based GIS that analyzes the dwellings by performing two main types of spatial queries, Spatial Relationship and nearest neighbor, the latter retrieves the nearest distance from each dwelling to pre-defined and user-defined points of interest.

- By enabling this technology, the customer's aim is to have a shorter response time to Real Estate companies that sent their information. Furthermore, to be accurate in the calculation by using the geometry of the dwelling's perimeter instead of using the centroid as it was being used before the implementation of this project.

Project Objectives

- To redefine the process of Reception, Verification, and Qualification of the housing base maps (just a set of dwellings drawn in a AutoCAD Drawing together with infrastructure features like schools, squares, supermarkets, mini markets, health care centers and so forth) sent by the Real Estate companies using Autodesk Technology.

- To store the map data after being received and validated into Oracle Spatial DB.

General Procedure for Spatial Analysis

1) Creation of an SDF file with the housing base map from an AutoCAD Map Drawing.
2) The developer loads the file through the system.
3) The map is reviewed and validated by Geospatial Operators.
4) The geospatial data from the map is transferred by the operators.
5) The transfer of the elements is performed using FDO Technology (fdo.osgeo.org).
6) The work order is scheduled in order to perform the queries. (3 times a day)
7) When the time comes the dwelling order is being processed with two main groups of queries:
   - Relation between feature geometries.
   - Distances.
8) The result is stored into a DB Table.
9) A data transfer is performed between this application and the main system.

Best Practices for Importing data from Autodesk to Oracle

Spatial Feature	Complaint	Workaround
Original Developer's drawing is feature object oriented.	No	Use of AutoCAD Map instead of plain AutoCAD
Spatial Data File format supports OGC geometry validation.	No	Develop custom tools in order to fix incorrect oriented geometry and duplicated vertices.
Geometry exported in the same dimensionality as defined in the drawing	No	Use of Oracle Spatial API to convert dimensionality.
Geometry loaded on the fly could be validated before spatial analysis	No	VALIDATE_GEOMETRY_WITH_CONTEXT

Performing Spatial Analysis with PL/SQL.

Requirements for Spatial Analysis regarding data layers regulated by federal agencies:

- Layers must have the same dimensionality (2D).
- They must be imported using AutoCAD Map 3D with FDO.
- They must be validated with Spatial API.
  - **VALIDATE_LAYER_WITH_CONTEXT**
- They must have spatial indexes defined in a different table space.
- They must have unique/non-unique indexes for foreign keys.

Dealing with Spatial Analysis Queries

Create two big groups of queries:

- Nearest neighbour distance. Needed to be performed for each dwelling against the closest point of interest not exceeding a maximum radius, and retrieving the resulting distance between the house and the point of interest.

- SDO_RELATE Operator. Needed to be performed either with a set of houses or for each dwelling.

Regarding Nearest Neighbour

SDO_BATCH_SIZE=10 specifying a max batch size of 10 for improve performance, also allows you to have more than one WHERE condition for the SDO_NN geometry table.

DISTANCE=X UNIT=METER specifying a maximum distance as requested in business rules. UNIT by default in geodesic context is meters.

ROWNUM to restrict the number of results.

SDO_NUM_RES should be used if only proximity matters otherwise use above.

SDO_NN_DISTANCE performance improvement with FIRST_ROWS Hint , when queries are optimized for response time Oracle Spatial returns the first rows in the shortest time possible. (NEW in 11gR2)

Example of Nearest Neighbour Query:

```
SELECT SCHOOL_ID,SCHOOL_NAME, D INTO ID,NAME, DIST
  FROM
  (
   SELECT /*+ FIRST_ROWS */ SCHOOL_ID,SCHOOL_NAME, SDO_NN_DISTANCE(1) D
   FROM
    SCHOOLS S --,DWELLINGS DW
   WHERE S.TYPE = :TYPE   ← More tan one WHERE condition for SDO_NN Geometry
           -- AND DW.CUV = :PID
   AND SDO_NN (S.GEOMETRY, :GEOM, 'SDO_BATCH_SIZE=10 DISTANCE=4000',1)='TRUE'
   ORDER BY  D)
  WHERE ROWNUM < 2;
```

Using SDO_NUM_RES

```
FOR VIV IN (
        SELECT NAME
        FROM  BIG_CITIES CITIES,SMB_CONSTRUCCIONES V
        WHERE V.CUV =PID
        AND SDO_NN (CITIES.GEOMETRY,V.GEOM, 'SDO_NUM_RES=1')='TRUE'
        )
LOOP
        NOM_LOC_URB := VIV.NAME;
END LOOP;
```

Performance analysis

OPERATION	OBJECT_NAME	CARDINALITY	COST
SELECT STATEMENT		1	8
SORT (ORDER BY)		1	8
COUNT (STOPKEY)			
Filter Predicates			
ROWNUM<2			
NESTED LOOPS		1	7
TABLE ACCESS (BY INDEX ROWID)	SMB_CONSTRUCCIONES	1	3
INDEX (UNIQUE SCAN)	SMB_CONSTR_CUV_IDX	1	2
Access Predicates			
V.CUV=U'1306009899100151'			
TABLE ACCESS (BY INDEX ROWID)	LOC_URBANAS_2013	1	7
DOMAIN INDEX ((SEL: 0.100000 %))	LOC_URBANAS_2013_GEOM1		1
Access Predicates			
MDSYS.SDO_NN(LOC.GEOMETRY,V.GEOM,'SDO_BATC			

OPERATION	OBJECT_NAME	CARDINALITY	COST
SELECT STATEMENT		5	6
NESTED LOOPS		5	6
TABLE ACCESS (BY INDEX ROWID)	SMB_CONSTRUCCIONES	1	3
INDEX (UNIQUE SCAN)	SMB_CONSTR_CUV_IDX	1	2
Access Predicates			
V.CUV=U'1306009899100143'			
TABLE ACCESS (BY INDEX ROWID)	LOC_URBANAS_2013	5	6
DOMAIN INDEX ((SEL: 0.100000 %))	LOC_URBANAS_2013_GEOM1		3
Access Predicates			
MDSYS.SDO_NN(LOC.GEOMETRY,V.GEOM,'SDO_NUM_RES=1'):			

Why not use SDO_WITHIN_DISTANCE?

```
SELECT MIN(SDO_GEOM.SDO_DISTANCE(S.GEOM,DW.GEOM,0.5,'UNIT=METER')) INTO DIST
FROM SCHOOLS S , DWELLINGS DW
WHERE DW.CUV = :PID
AND S.TYPE = :TYPE
AND SDO_WITHIN_DISTANCE (S.GEOM, DW.GEOM,'DISTANCE=4000')='TRUE';
```

SDO_WITHIN_DISTANCE may return inaccurate results due to a BUG in 11gR2 11.2.0.1 – 11.2.0.3.

In Oracle 12c seems that this issue was solved and we have to verify the performance improvement for SDO_WITHIN_DISTANCE vs SDO_NN with SDO_NN_DISTANCE.

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Performance SDO_WITHIN_DISTANCE

```
SELECT S.DESCRIPCIO  NOMBRESALUD, SDO_NN_DISTANCE(1) SALUDDIST
FROM SALUD S,SMB_CONSTRUCCIONES V
WHERE V.CUV ='1306009899100151' AND
SDO_NN (S.geometry,V.GEOM, 'SDO_NUM_RES=1 DISTANCE=10000 UNIT=METER',1)='TRUE';
```

OPERATION	OBJECT_NAME	CARDINALITY	COST
SELECT STATEMENT		27	15
NESTED LOOPS		27	15
TABLE ACCESS (BY INDEX ROWID)	SMB_CONSTRUCCIONES	1	3
INDEX (UNIQUE SCAN)	SMB_CONSTR_CUV_IDX	1	2
Access Predicates			
V.CUV=U'1306009899100151'			
TABLE ACCESS (BY INDEX ROWID)	SALUD	27	15
DOMAIN INDEX ((SEL: 0.100000 %))	SALUD_GEOMETRY_SI		3
Access Predicates			
MDSYS.SDO_NN(S.GEOMETRY,V.GEOM,'SDO_NUM_RES=1 DIS			

Performance SDO_WITHIN_DISTANCE

SELECT * FROM

(

**SELECT** S.DESCRIPCIO NOMBRESALUD ,SDO_GEOM.SDO_DISTANCE**(**S.GEOMETRY,V.GEOM,0.5,'UNIT=METER'**)** SALUDDIST

FROM SALUD S,SMB_CONSTRUCCIONES V

WHERE V.CUV **=** '1306009899100151' **AND** SDO_WITHIN_DISTANCE **(**S.GEOMETRY,V.GEOM,'DISTANCE=10 UNIT=KILOMETER'**)=**'TRUE'

ORDER BY 2

)

WHERE ROWNUM <2

OPERATION	OBJECT_NAME	CARDINALITY	COST
SELECT STATEMENT		1	67
COUNT (STOPKEY)			
Filter Predicates			
ROWNUM<2			
VIEW		275	67
SORT (ORDER BY STOPKEY)		275	67
Filter Predicates			
NESTED LOOPS		275	66
TABLE ACCESS (BY INDEX ROWID)	SMB_CONSTRUCCIONES	1	3
INDEX (UNIQUE SCAN)	SMB_CONSTR_CUV_IDX	1	2
Access Predicates			
V.CUV=U'1306009899100151'			
TABLE ACCESS (BY INDEX ROWID)	SALUD	275	66
DOMAIN INDEX ((SEL: 0.100000 %))	SALUD_GEOMETRY_SI		3
Access Predicates			
MDSYS.SDO_WITHIN_DISTANCE(S.GEOMETRY,V.GEOM,'			

Regarding SDO_RELATE

The order of the geometry and query window matters!
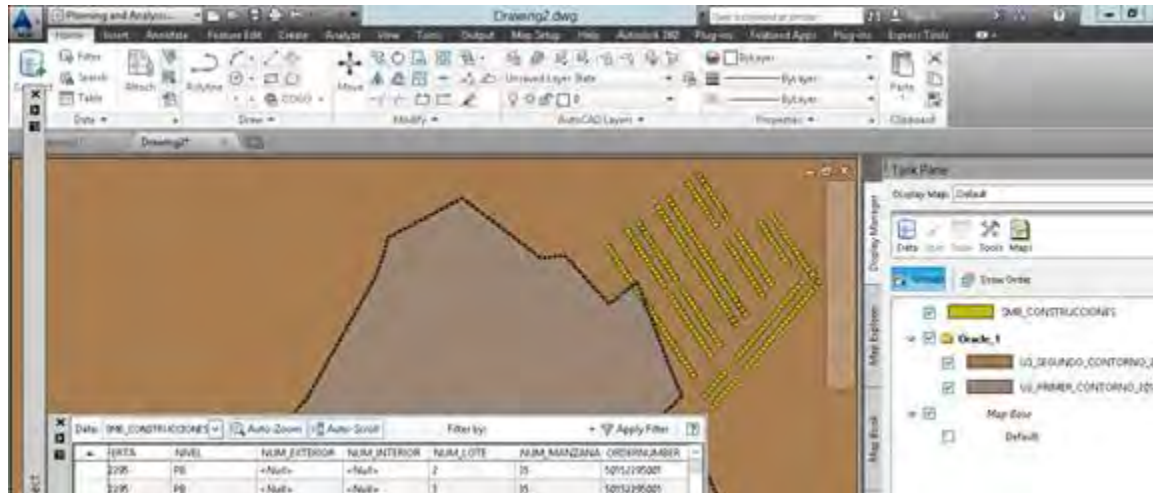
It could be common sense to query this way:

SDO_RELATE (DWELLING.GEOM,DISTRICTS.GEOMETRY,'MASK=INSIDE+COVEREDBY+
TOUCH+OVERLAPBDYINTERSECT')='TRUE'

Regarding SDO_RELATE

However since we do filter out all dwellings except one, we had to inverse the order in the spatial operator for performance improvement.

SDO_RELATE (DISTRICTS.GEOMETRY,DWELLING.GEOM,
'MASK=COVERS+CONTAINS+TOUCH+OVERLAPBDYINTERSECT')='TRUE'

We can use also the HINT /*+ ORDERED*/ but it depends on the explain plan.

Bulk vs Single queries

We classified SDO_RELATE operations in two big groups: single row and multiple row queries.

For the multiple row the resulting spatial relationship applies to all the dwellings, and we did update in a PL/SQL block, however in some queries we did use MERGE statement.

Tips

- Be aware HINTS for Spatial Operators may be helpful.

- Make sure geometries are valid.

- Use `SDO_UTIL.INTERIOR_POINT` to avoid always calculating the greatest area of the intersection of overlapping polygons.

- Analyze the different ways of writing a spatial query and review the explain plan. In 12c better execution plans are generated for spatial.

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Tips

Regarding PL/SQL:

- Use implicit cursors to avoid handling `NO_DATA_FOUND` exception.
- Use MERGE statement wherever is possible, better performance.
- Use dynamic SQL and create generic sub procedures.

Regarding SDO_RELATE:

- Calculate the number of candidate rows of both tables, and use the fewer one as the query_window driver.

Example of Dynamic SQL

```
DECLARE
TABLENAME VARCHAR2(30);
RADIUS VARCHAR2(100);
DIST NUMBER;
SQL_STMT VARCHAR2(500);
COND VARCHAR2(50);
BEGIN
SQL_STMT := 'SELECT dist FROM  (SELECT /*+ FIRST_ROWS */ SDO_NN_DISTANCE(1) dist FROM '||
TABLENAME|| ' EQM, SMB_CONSTRUCCIONES V WHERE EQM.IDOFERTA = :OFERTA AND SDO_NN
(EQM.geom,:PGEOM,:COND,1)="TRUE" ' || ' ORDER BY  SDO_NN_DISTANCE(1)) WHERE rownum < 2';
COND:='SDO_BATCH_SIZE=10 UNIT=METER DISTANCE='||RADIUS;
EXECUTE IMMEDIATE SQL_STMT INTO DIST USING PGEOM,OFERTA,COND;
EXCEPTION
    WHEN NO_DATA_FOUND THEN
     DIST:= NULL;
END;
```
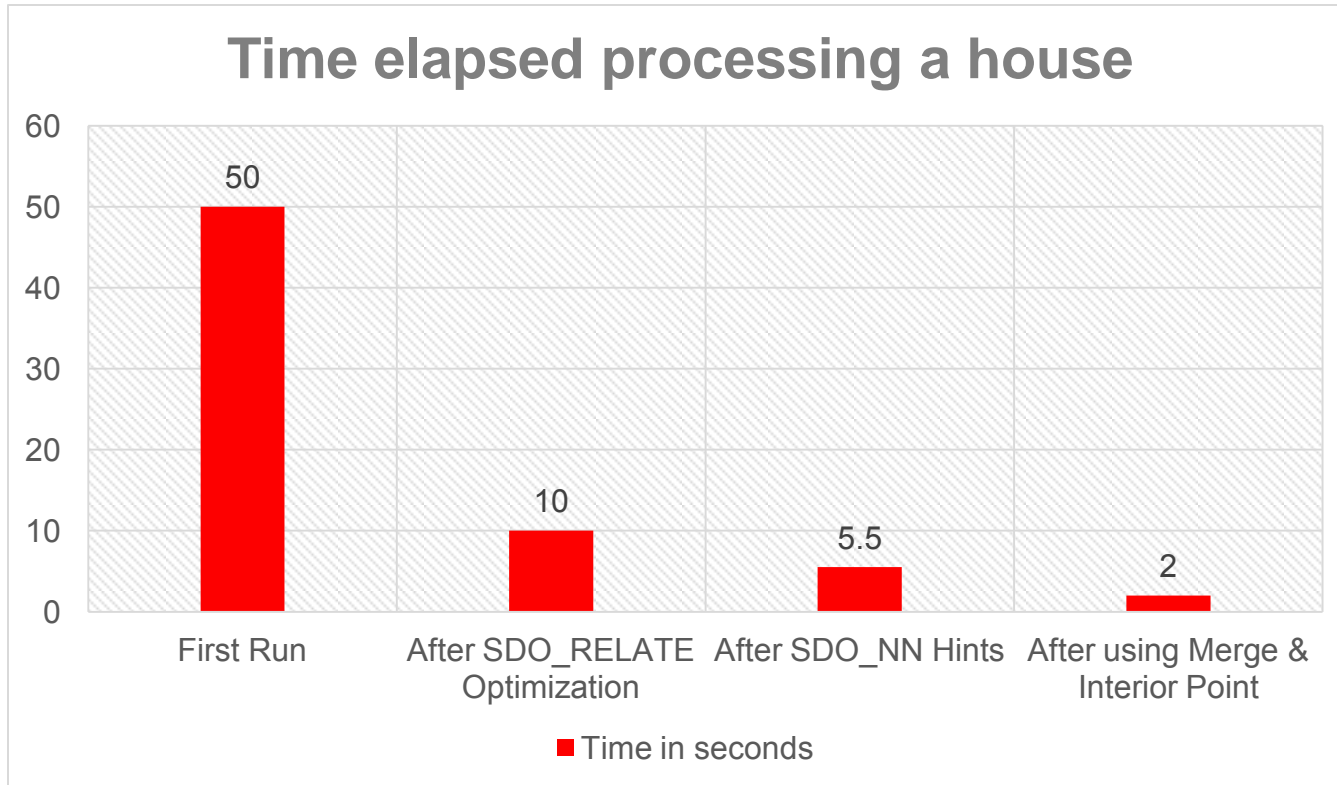
Final Achievements

Time elapsed processing a house

First Run: 50
After SDO_RELATE Optimization: 10
After SDO_NN Hints: 5.5
After using Merge & Interior Point: 2

■ Time in seconds

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Final Achievements

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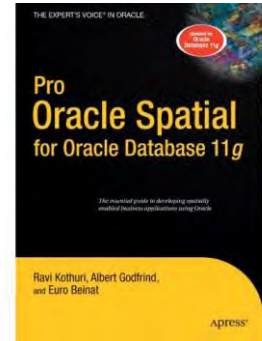
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Pro Oracle Spatial for Oracle Database 11g
By Albert Godfrind y Euro Beinat

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