Oracle’s Spatial Technologies 101

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Oracle Spatial and Graph option

Graph Features

- Network Data Model graph
- W3C RDF Semantic graph
Oracle Spatial and Graph option

Spatial Features

- Spatial Data Types and Models
- Spatial Indexes and Analysis
Agenda

- Location-Enabling the Enterprise
- Overview of Oracle’s Spatial Technologies
  - Oracle Spatial and Graph, Locator
  - Oracle MapViewer
  - BI and Apps
  - Exadata
- 12c Release Highlights
- Summary and Resources
Why Is Location Information Important?

- Maps convey complex information and context compactly and effectively
- Location information is a key part of managing any business
- Useful across various industries: e.g. agriculture, banking, insurance, retail, telecomm, healthcare
- Oracle applications, analysis and reporting tools can now query, manage, and display location information
What is spatial data?

- Business data that contains or describes location
  - Street and postal address (constituents, customers, warehouse)
  - Sales data (sales territory, customer registration, etc.)
  - Assets (cell tower, fire hydrant, electrical transformer, etc.)
  - Geographic features (roads, rivers, parks, etc.)
- Anything connected to a physical location
- Every database in the world contains some form of business data that can be leveraged using spatial technologies
Spatial Information Has Many Uses

<table>
<thead>
<tr>
<th>Information Type</th>
<th>Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address</td>
<td>Map customers, stores, and business relationships</td>
</tr>
<tr>
<td>Roads, facilities, infrastructure …</td>
<td>Logistics planning, trace and manage fixed or mobile assets</td>
</tr>
<tr>
<td>Administrative areas (zip, tax, county, floodplain, real estate, sales territories…)</td>
<td>Summarize, Drill down, Map key performance indicators</td>
</tr>
<tr>
<td>Satellite imagery, 3D models</td>
<td>Risk assessment, engineering planning, asset maintenance</td>
</tr>
</tbody>
</table>
## Usage across industries

<table>
<thead>
<tr>
<th>Local Government</th>
<th>Agriculture</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Jurisdiction</td>
<td>• Land use, ownership</td>
</tr>
<tr>
<td>• Tax assessment, zoning</td>
<td>• Forecasting, yield analysis, crop rotation</td>
</tr>
<tr>
<td>• Public facility planning</td>
<td>• Precision farming, optimize irrigation and fertilizer use</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Consumer Packaged Goods</th>
<th>Healthcare</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Product line market share analysis</td>
<td>• Service area, patient origination analysis</td>
</tr>
<tr>
<td>• Vending machine location, product mix</td>
<td>• Provider network analysis</td>
</tr>
<tr>
<td>• Marketing, promotions analytics</td>
<td>• Tracking spread of disease</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Real Estate</th>
<th>Transportation, Utilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Appraisal/Risk assessment</td>
<td>• Asset management</td>
</tr>
<tr>
<td>• Community, neighborhood profiles</td>
<td>• Workforce scheduling, management</td>
</tr>
<tr>
<td>• Tenant mix analysis</td>
<td>• Network and service planning</td>
</tr>
</tbody>
</table>
Location-Enabled Business Applications

- Geocoding
- Spatial searches
- Routing
- Mapping
Specialist Geospatial Applications

Geometry
Topology
GeoRaster
Networks
LRS
Geodetic
Long Transactions
3D (Point clouds, LIDAR)
Our Spatial Technology Strategy

• Location-Enable the Oracle Stack
  – Oracle Spatial and Graph, Oracle Database Locator
  – Oracle Fusion Middleware MapViewer

• Partnerships With Leading Spatial Vendors
  – Software vendors
  – Integrators
  – Data suppliers

• Commitment To Standards
  – Open Geospatial Consortium, SQL, ISO TC-211, TC-204

• Part of Oracle applications, tools, engineered systems
  – Exadata, Exalogic, Exalytics
  – Oracle Business Intelligence Enterprise Edition, Fusion, e-Business, CRM, Primavera, Utilities, Retail and more
Oracle In Database Analytics

- Statistical Data Mining
- Text
- Graph
- Spatial
- Semantic

In-Database MapReduce

SQL MapReduce

In-Database Hadoop

2 miles
Oracle’s Spatial Stack – Enterprise Approach

Key Technologies

• Oracle Locator
• Oracle Spatial and Graph
• MapViewer
• Bundled Map Content
What’s the difference between what Oracle has and a GIS?

“A GIS is a unique kind of database of the world.”
Fully exploit and support Standards-based, IT Architecture

- **Scalability** - large data volume
- **Availability** – tens of thousands of users
- **Security** – protect sensitive location data
- **Performance** – timely query response
- **Accessibility** – to enterprise applications
- **Manageability** – leverage IT resources
Open and Interoperable

Oracle Spatial and Graph
Most Widely Deployed Spatial Database

- **Utilities**

- **Telco & Wireless LBS**
  - AT&T, Bell South, British Telecom, Cingular, DoCoMo, KDDI, Intrado, JPhone, Nextel, Sprint, T-Mobile, Telkom, Telenor, Telstra, Telus, Telia, Cellcom, Verizon, VIAG, Vodafone, Wind

- **Transportation Management**
  - German Rail, Austrian Rail, California, Iowa, Florida, Maine, Maryland, Minnesota, New York, Oklahoma, Pennsylvania, Alabama, Alberta, London Rail, Netherlands Transport, Australia,

- **Local Authorities**
  - Berlin, Dutch Police, New York City, Chicago, Los Angeles, San Jose, San Mateo, Washington DC, Cleveland, Detroit, Phoenix, Winnipeg, Vancouver, Edmonton, Stockholm…

- **National Mapping, Cadasters & Hydrographic Agencies**
  - Ordnance Survey (UK, IR, NI), US Census, NIMA, USGS, US Army, Denmark, Sweden, The Netherlands, Poland, Australia, Singapore Land Authority
Overview:
Spatial Database
Oracle Spatial and Graph option

"Points"
"Lines"
"Polygons"

Web Services (OGC)
Rasters
3D
Topologies
Network Graphs
Geocoding
Routing
RDF Semantic Graphs
Oracle Spatial Database Services
Everything through SQL

- Native Geometry Data Types

- Self Balancing R-tree Indexing

- Full Query and Analysis

```
SELECT a.owner_name, a.acquisition_status
FROM properties a, projects b
WHERE sdo_within_distance
  (a.property_geom, b.project_geom,
   'distance = .1 unit = mile') = 'TRUE'
and b.project_id=189498;
```
Spatial primitive types

Points: define a location (X,Y).
Often used to represent location of things like stores, customers, vehicles, or assets

Lines: define a linear extent using a sequence of points (X1, Y1), (X2, Y2) … (Xn, Yn).
Often used to represent things like roads, pipelines, or routes

Polygons: define an area using a sequence of points (X1, Y1), (X2, Y2) … , (XnYn), (X1, Y1).
Often used to represent things like sales territories, postal code boundaries, or tax zones
“Spatial” Tables

- Just like regular tables
- Contain a column of type SDO_GEOMETRY to store the geometric shape of the objects

```
CREATE TABLE map_countries (  
id NUMBER PRIMARY KEY,  
name VARCHAR2(30),  
geometry SDO_GEOMETRY
);
```
Spatial Data

- Contains a list of X and Y coordinates for points that describe the shape

SQL> SELECT geometry FROM map_countries WHERE name = 'France';

SDO_GEOMETRY(  
2007, 8307, NULL,  
SDO_ELEM_INFO_ARRAY(1, 1003, 1, 2209, 1003, 1, 2427, 1003, 1, 2465, 1003, 1, 2511, 1003, 1),  
SDO_ORDINATE_ARRAY(  
5.63215688, 45.102186, 6.77118888, 45.142299, 6.86673792, 45.115519, 6.90344604, 45.12864, ...
-3.2208998, 47.377866, -3.245697, 47.353725  
)}

Coordinate system of the shape (here Longitude/Latitude)

Coordinates of one point of the shape
SELECT c.holding_company, c.location 
FROM competitor c, 
    bank b 
WHERE b.site_id = 1604 
AND SDO_WITHIN_DISTANCE(c.location, 
    b.location, 
    'distance=2 unit=mile') = 'TRUE'

Find all competitors within 2 miles of Northport Branch
Can I use OEM, APEX, SQL Developer and Data Modeler?
How Spatial Enhances Application Workflow

Display

Add Maps & Reports to your Application

Analyze

Find Proximity, Location, Routing

Geocode

Convert addresses into coordinates

Data

Manage commercial and customer geospatial data
(Oracle Database includes HERE - NAVTEQ boundary data for 60+ countries)
Data

- **Oracle Bundled Map Content**
  - Major roads, admin (city county, state, country boundaries) for whole world from HERE (Navteq)

- **3rd Party Specialized Map Data**
  - HERE (Navteq)
  - TomTom
  - DigitalGlobe
  - Intermap

3rd Party Mapping Services
- Google Maps
- Microsoft Bing
- Nokia
Geocode:

- Generates latitude/longitude (points) from address
- International addressing standardization
- Formatted and unformatted addresses
- Tolerance parameters support fuzzy matching
- 100% Java, open and scalable
- Record-level and batch processes
- Data provided by leading data vendors
Analyze: Geospatial Data

Find all competitors within 2 miles of Northport Branch

```
SELECT c.holding_company, c.location
FROM competitor c, bank b
WHERE b.site_id = 1604
AND SDO_WITHIN_DISTANCE(c.location, b.location, 'distance=2 unit=mile') = 'TRUE'
```
Native Spatial Analyses

Acquiring rights-of-way for a proposed road widening project

```
SELECT a.owner_name, a.acquisition_status
FROM properties a, projects b
WHERE sdo_within_distance (a.property_geom, b.project_geom,
‘distance = .1 unit = mile’) = ‘TRUE’ and b.project_id=189498;
```
Display: Generate Powerful Maps
Oracle Fusion Middleware MapViewer

- A J2EE component (.ear) for developing web mapping applications.
- Renders data from Oracle Spatial and Graph (also WMS, WFS, .shp).
- Background maps can be from 3rd party providers.
- Provides JavaScript, Java, and XML APIs for web mapping apps.
Spatial Analysis and Maps in Oracle Applications, Tools and BI

Oracle Fusion Business Suite: Oracle Transportation Manager

Oracle BI 11g Mobile

Oracle SQL Developer

Health Sciences

OBIEE Map View

Utilities Outage Management
Demo
Many More Rich Features – the Most Advanced Geospatial Database Platform

- Linear Referencing
- Geocoding & Routing
- Planar Networks
- Spatial Web Services
- 3D, Point Clouds, and LIDAR
- Raster Imagery
Advances with Oracle Database 12c
Spatial Features

Dramatic Performance

Simplified Application Development
Oracle Spatial and Graph
Dramatic Performance and Simplified Application Development

Oracle Spatial and Graph 12c

- Up to 100x Faster Spatial Operations
- Parallel Raster Query and Processing
- Extended 3D and Point Cloud Support
- Graph Views on Relational Tables
- Enhanced Reasoning
- Large Scale Drive Time Analysis
Dramatically Improved performance

Core Spatial Functions and Operations

- **ANYINTERACT, INSIDE:** 20-30x
- **GEOM DISTANCE:** 40x
- **WITHIN DISTANCE:** 10x
- **VALIDATE GEOMETRY:** 4x

Oracle Database Locator and Spatial and Graph
Vector Performance Acceleration

“Turbo-charged” spatial functions and operators

Spatial and Graph option Performance Improvements

- Join: 50-100x
- Touch: 50x
- Contains, Overlaps: 50x
- Complex masks: 50x
Parallel Raster Operations

- MANY RASTER FUNCTIONS CAN PARALLELIZE
- SERIAL OPERATIONS PERFORM UP TO 3X FASTER
- SCALES TO OVER 100X FASTER ON HIGHLY PARALLEL SYSTEMS

SDO_GEOR_RA.classify
SDO_GEOR_RA.findCells
SDO_GEOR_RA.rasterMathOp
SDO_GEOR_RA.rasterUpdate
SDO_GEOR_AGGR.mosaicSubset
SDO_GEOR.generatePyramid
Benefits on Oracle Exadata Database Machine
Extreme Performance for Spatial Workloads

- Oracle’s spatial datatype exploits Exadata’s processing power, bandwidth, and parallelism: security, compression, partitioning services
  - Breaks new boundaries for ingesting spatial data
  - Data warehouse performance increases of up to 100x faster
  - Box and distance queries up to 25x faster
  - Spatial query analysis up to 100x faster
  - Extreme compression for point data sets with EHCC
  - Successful customer deployments in government (eg environmental analysis/sensor data feeds), national cadasters, oil and gas, more
Oracle MapViewer – 11.1.1.7 Capabilities

- Rich client interactivity – HTML5 API
- Map data editing
- 3rd party data sources
- Support for online map services (eg HERE)
- Refreshed Web console
- Separate MVDEMO samples app
- A glassfish based quick start kit
Summary

Oracle delivers location analysis and mapping to enterprise applications for better decision making and customer service

- Integrate location information with business data
- Enrich business information with map graphics
- Enhance business processes with location analysis
- Support multiple vendor tools/apps using single valid source of geospatial data and open standards
- Deploy a single IT architecture for your business applications and mapping solutions
- Leverage Oracle scalability, security, and reliability
- Reduce cost & risk, increase productivity & ROI
Suggested Reading Material


  - ISBN 184968636X
Partner Specialization & Individual Certification

Get recognized for expertise in Oracle’s spatial and graph technologies

- Credentials for individuals & official partner specialization program through Oracle PartnerNetwork
- Exam information, training, business/competency requirements for partners, webcast
Oracle Spatial Summit and Location Intelligence

May 19-21, 2014 – Washington, DC

The premier training event for Oracle’s mapping & spatial technologies

- Technical talks and hands-on labs – led by Oracle experts
- Case studies from leading users
- Certification fast-track workshop
- Interact with the Spatial and Graph IOUG SIG user group
- Directions’ LI – learn about key trends from thought leaders – indoor positioning, analytics, more
- HERE & LocationTech Summits
- *Complimentary registration for government attendees

View the agenda & register at www.locationintelligence.net/dc
Communities

Connect and exchange knowledge with the user community

- **Oracle Spatial & Graph Special Interest Group:**
  - Social Networking Communities: LinkedIn, Google+, IOUG SIG
  - Conferences, user meetings year round: Oracle Spatial Summit (May in DC), OpenWorld, BIWA, local/regional user meetings

- Visit [OTN Spatial – Community](https://www.oracle.com/technetwork/community/special-interest-group-sponsored/otn-spatial-141546.html)
  Search online for “Oracle Spatial and Graph Community”

- Email [jean.ihm@oracle.com](mailto:jean.ihm@oracle.com) and Keith Bingham – SIG Membership Chair at [oraclespatialsig@gmail.com](mailto:oraclespatialsig@gmail.com)
Resources at Oracle Technology Network

- **Oracle Spatial and Graph:**  

- **Oracle MapViewer:**  

Access white papers, training, software downloads, sample code, updates, documentation, partner resources, case studies, videos, communities.
Q & A