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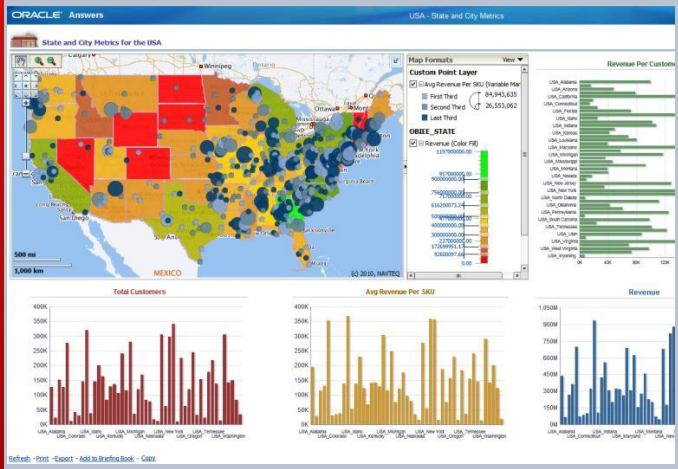
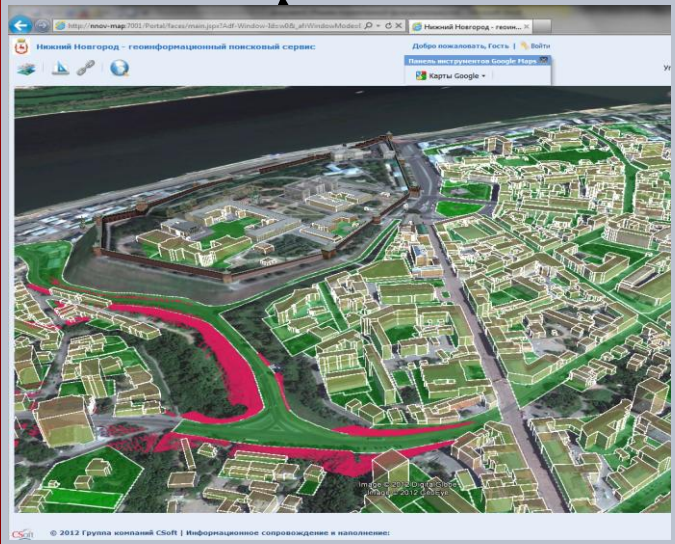
Oracle's Spatial Technologies 101

Jean Ihm
Product Manager, Oracle Spatial and Graph





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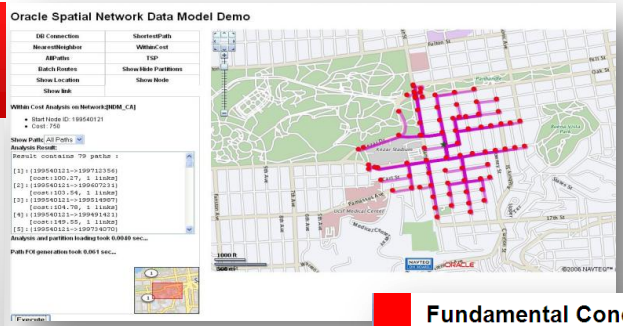
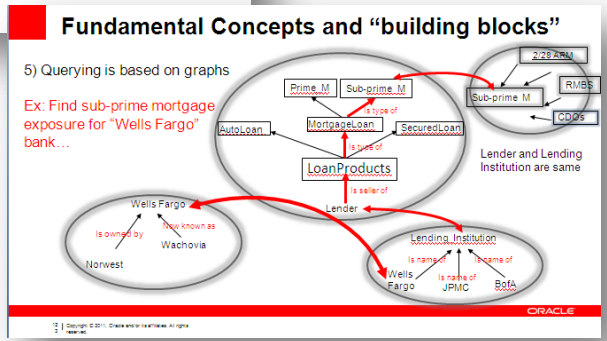
Oracle Spatial and Graph option

Graph Features

- Network Data Model graph
- W3C RDF Semantic graph





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Oracle Spatial and Graph option

Spatial Features

- Spatial Data Types and Models
- Spatial Indexes and Analysis

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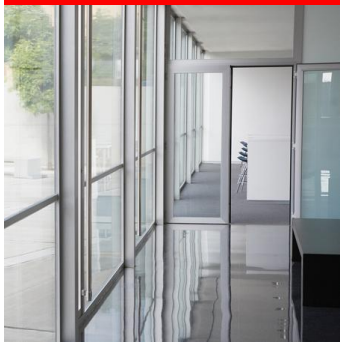
Agenda



- 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

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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

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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

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Spatial Information Has Many Uses

Information Type	Uses
Address	Map customers, stores, and business relationships
Roads, facilities, infrastructure …	Logistics planning, trace and manage fixed or mobile assets
Administrative areas (zip, tax, county, floodplain, real estate, sales territories...)	Summarize, Drill down, Map key performance indicators
Satellite imagery, 3D models	Risk assessment, engineering planning, asset maintenance

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Usage across industries

Local Government

- Jurisdiction
- Tax assessment, zoning
- Public facility planning

Agriculture

- Land use, ownership
- Forecasting, yield analysis, crop rotation
- Precision farming, optimize irrigation and fertilizer use

Consumer Packaged Goods

- Product line market share analysis
- Vending machine location, product mix
- Marketing, promotions analytics

Healthcare

- Service area, patient origination analysis
- Provider network analysis
- Tracking spread of disease

Real Estate

- Appraisal/Risk assessment
- Community, neighborhood profiles
- Tenant mix analysis

Transportation, Utilities

- Asset management
- Workforce scheduling, management
- Network and service planning

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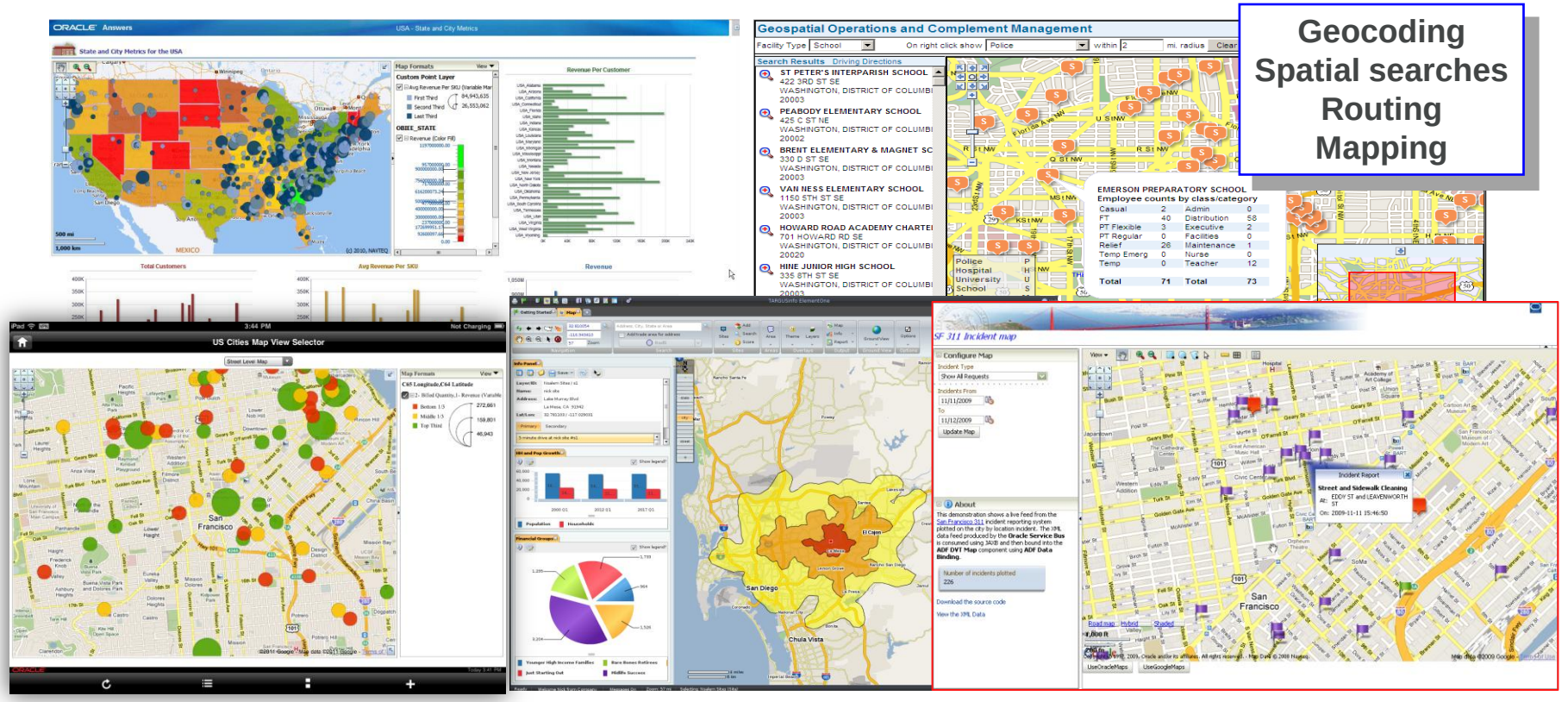
Location-Enabled Business Applications



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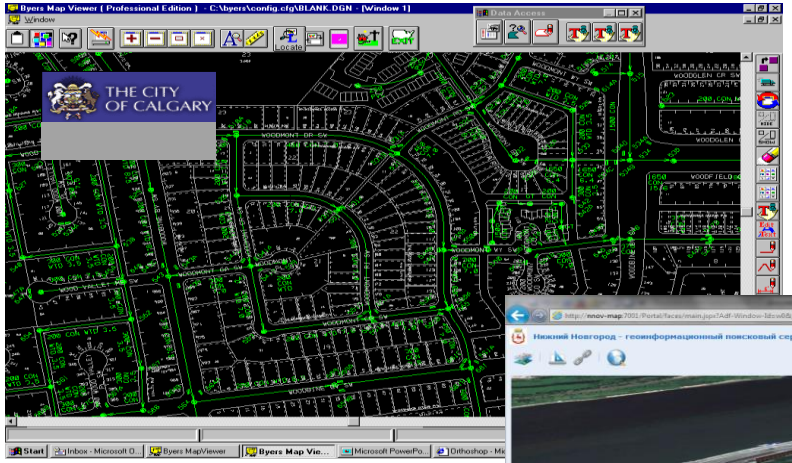
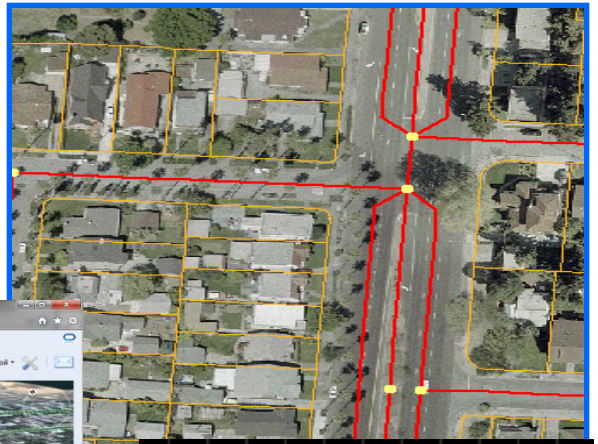
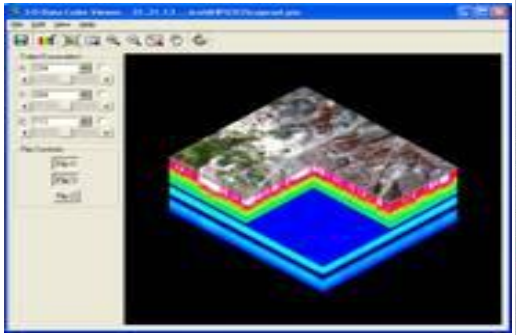
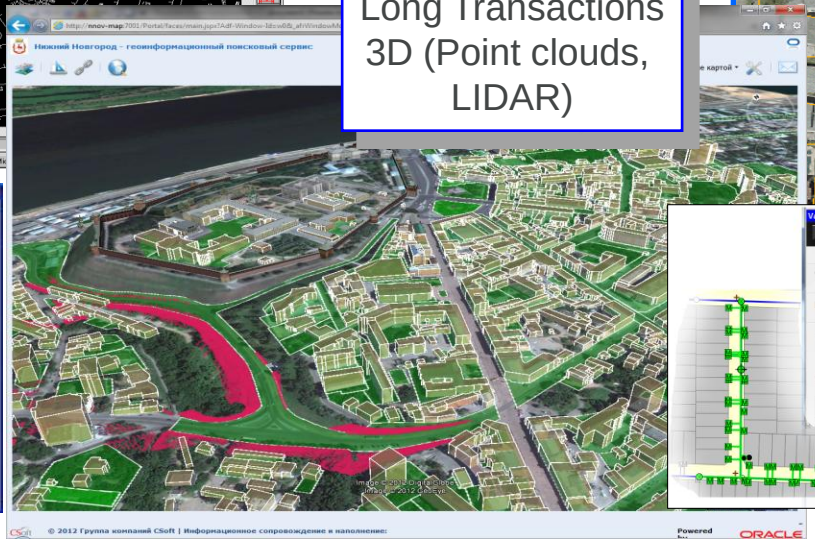
Specialist Geospatial Applications

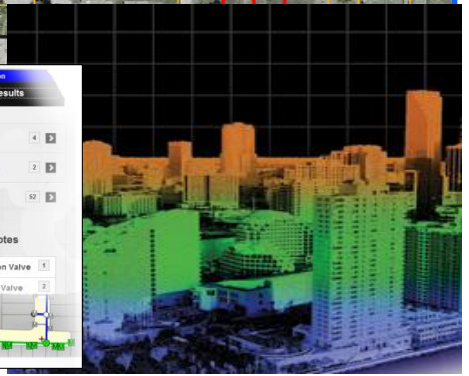


Geometry
Topology
GeoRaster
Networks
LRS
Geodetic
Long Transactions
3D (Point clouds, LIDAR)









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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 DATABASE

ORACLE FUSION MIDDLEWARE

ORACLE PARTNERNETWORK

OGC™ Principal Member

ISO

ORACLE FUSION APPLICATIONS

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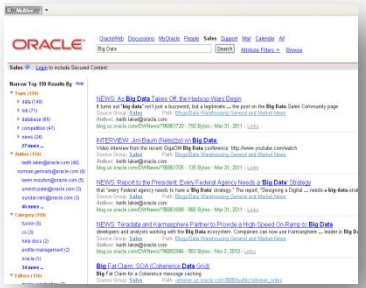
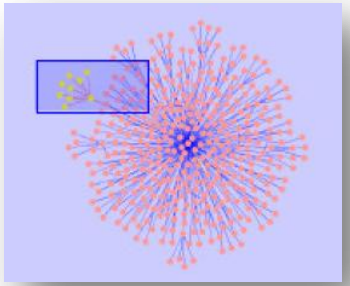
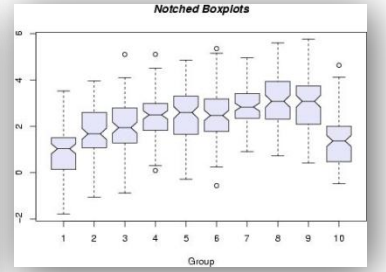
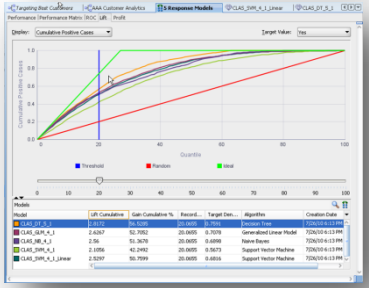
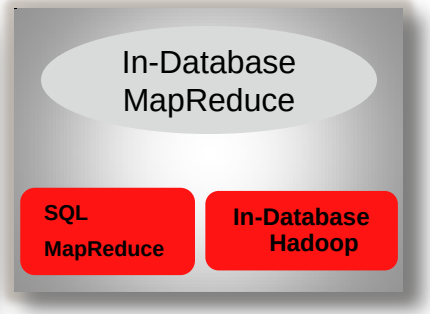
Oracle In Database Analytics











Statistical
Data Mining
Text
Graph
Spatial
Semantic
In-Database MapReduce

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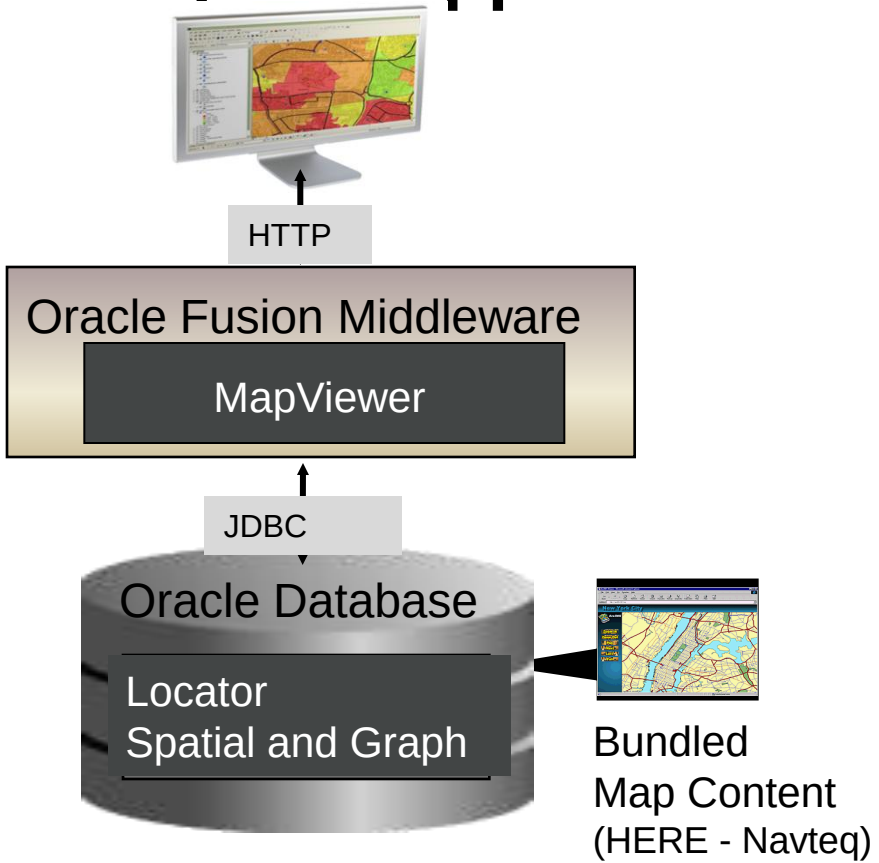
Oracle's Spatial Stack – Enterprise Approach

Key Technologies

- **Oracle Locator**
- **Oracle Spatial and Graph**
- **MapViewer**
- **Bundled Map Content**



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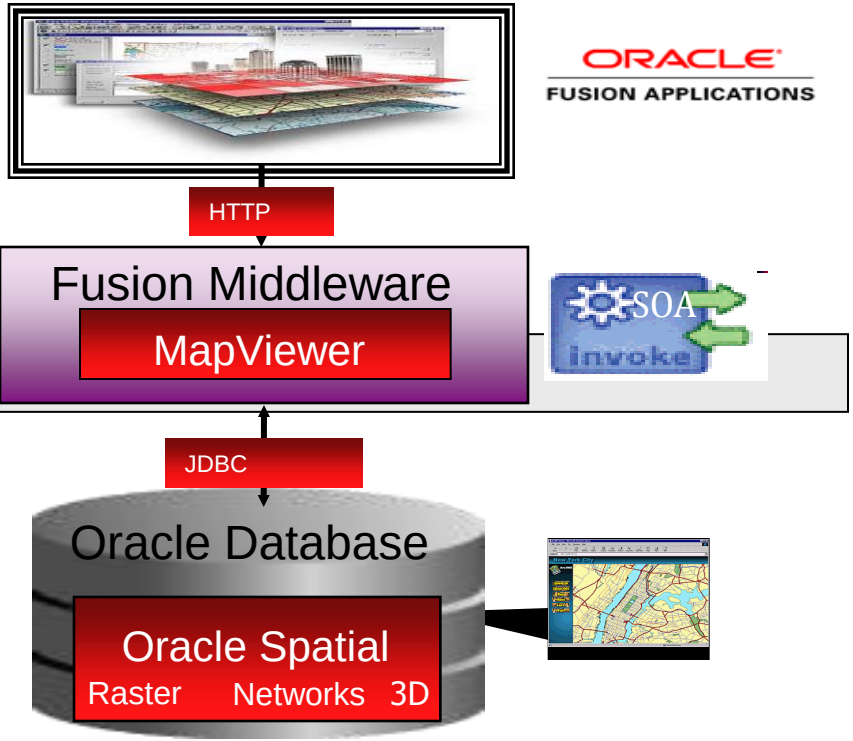
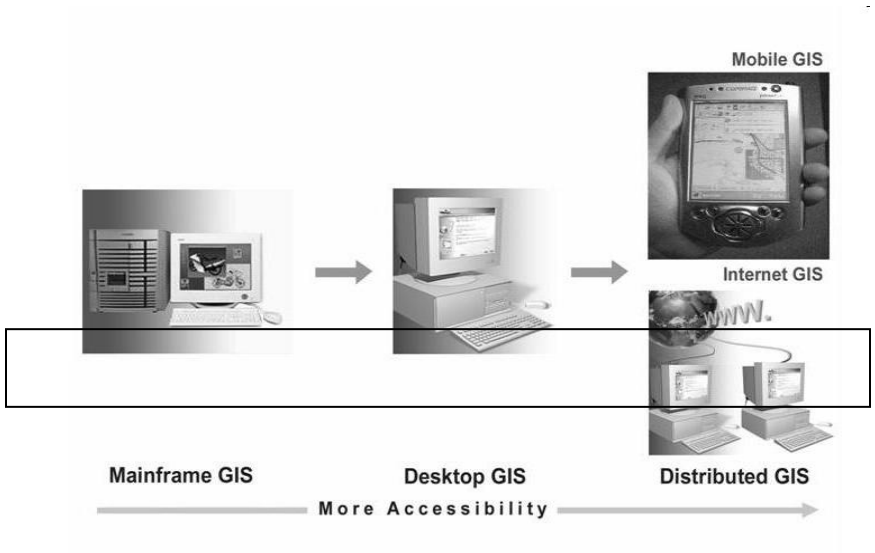
What's the difference between what Oracle has and a GIS?





"A GIS is a unique kind of database of the world."

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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

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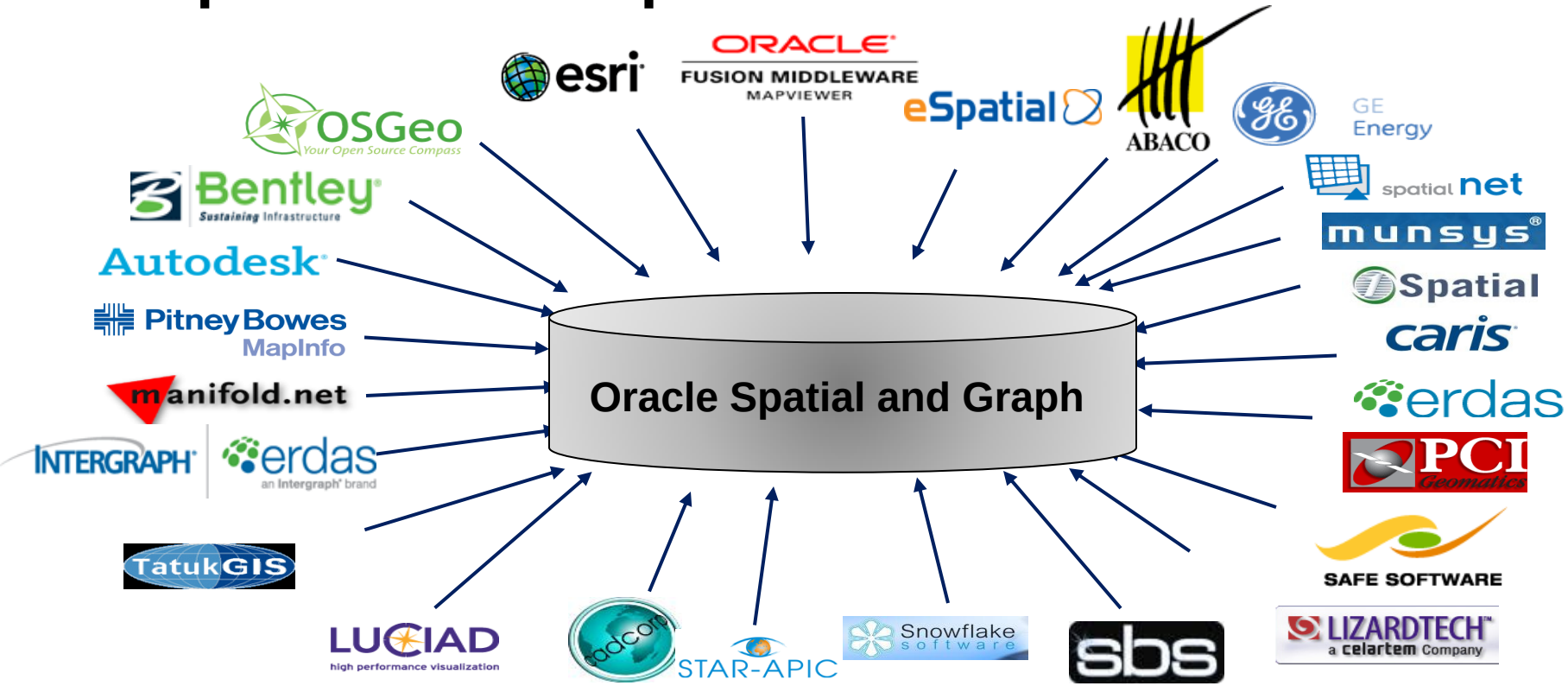
Open and Interoperable



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Most Widely Deployed Spatial Database

- Utilities
  - Northeast Utilities, Salt River Project, Omaha Public Power, Reliant, Southern, US DoE, Western Power Corp, Severn Trent, Bejing Power, Georgia Power, Czech Telem, Copenhagen Energy, Electrable, Gaz de France, Hydro-Quebec, Equitable Resources, Nova Naturgas, Sao Paulo Electric
- 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, Vodaphone, 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

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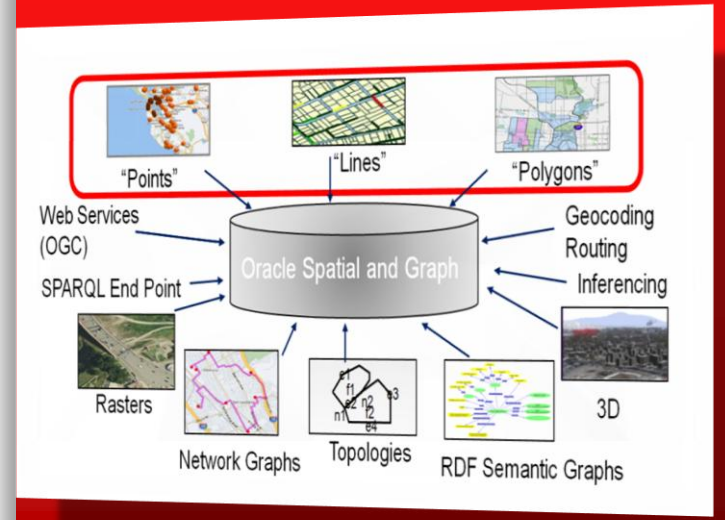
Overview: Spatial Database



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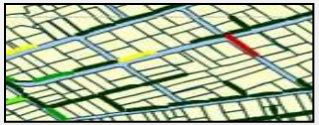
Oracle Spatial and Graph option

"Points"



"Lines"

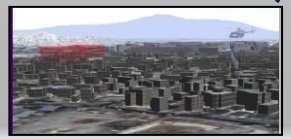
"Polygons"

Web Services (OGC)

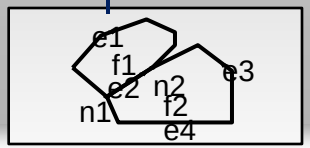
Oracle Spatial and Graph

Geocoding Routing

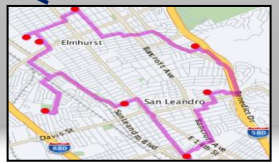
Rasters



3D



Topologies



Network Graphs

RDF Semantic Graphs

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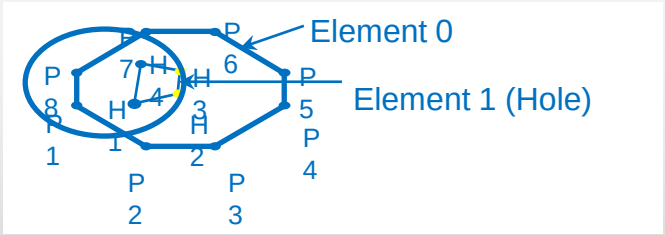
Oracle Spatial Database Services

Everything through SQL

- Native Geometry Data Types

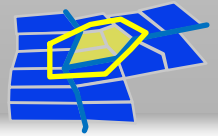


ROADS

RNAME	ID	TYPE	LANES	GEOMETRY
M40	140	HWY	6	
M25	141	HWY	4	

- Self Balancing R-tree Indexing

- Full Query and Analysis



Select, join, buffer, within distance, nearest neighbor, intersection, union, convex hull, centroid, ...

```
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;
```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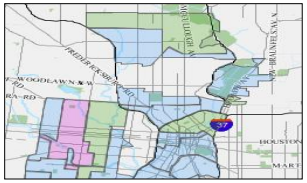
Spatial primitive types

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

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“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
);
```


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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(
    6.63215688, 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

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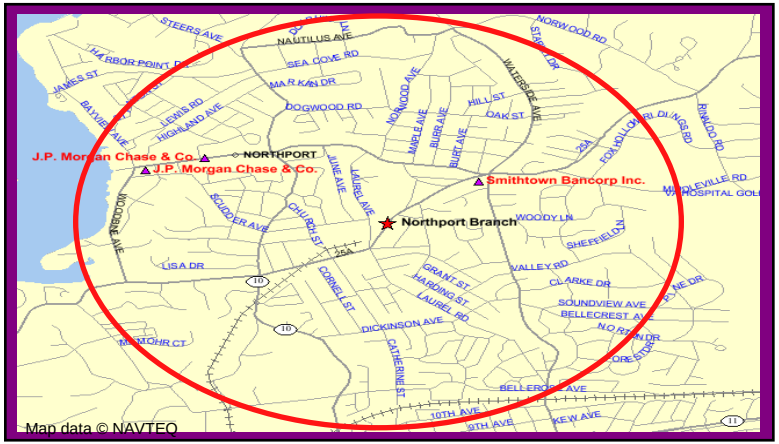
What does the SQL look like?

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'
```



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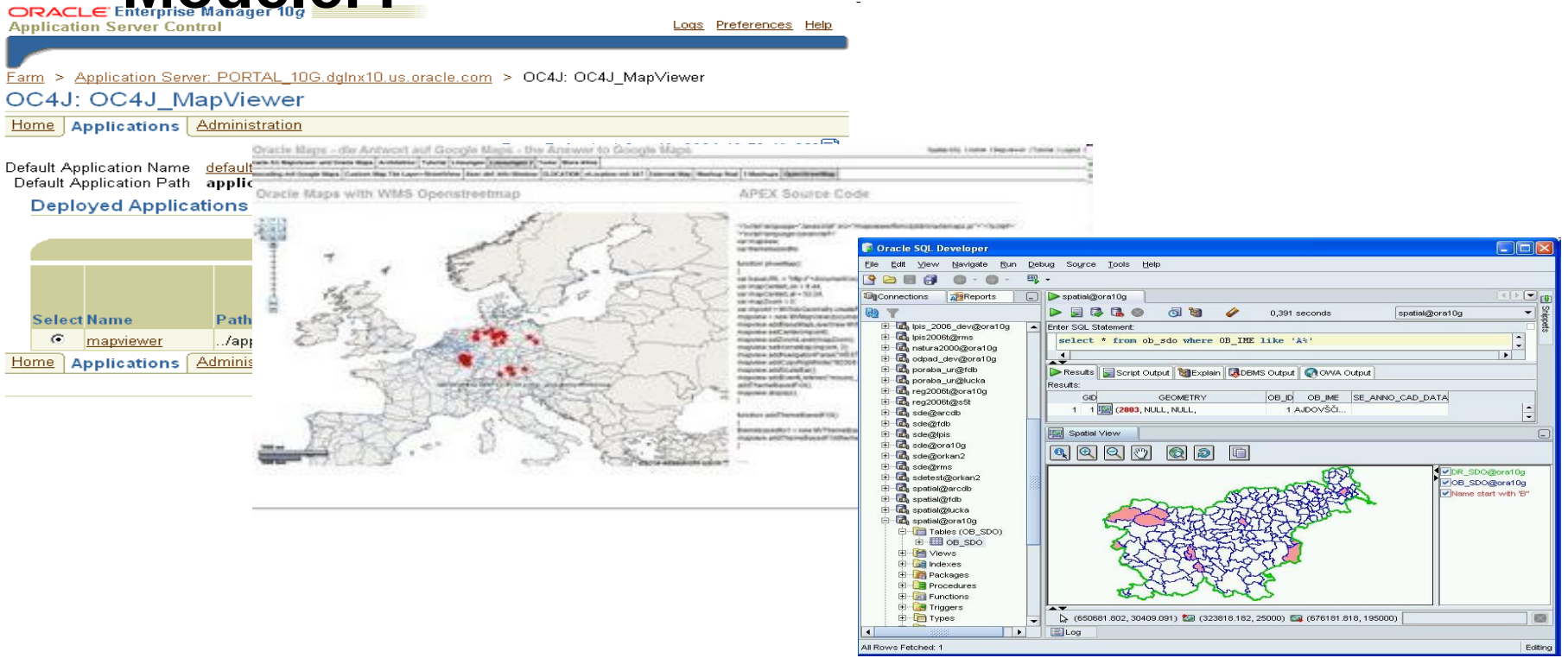
Can I use OEM, APEX, SQL Developer and Data Modeler?



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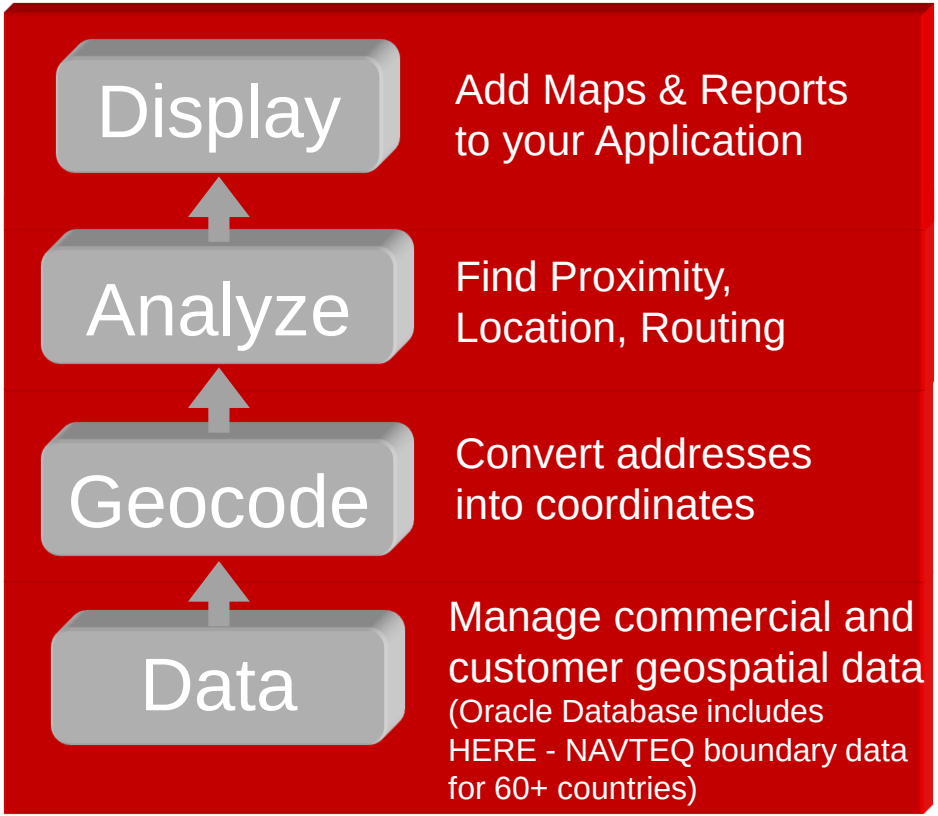
How Spatial Enhances Application Workflow



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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

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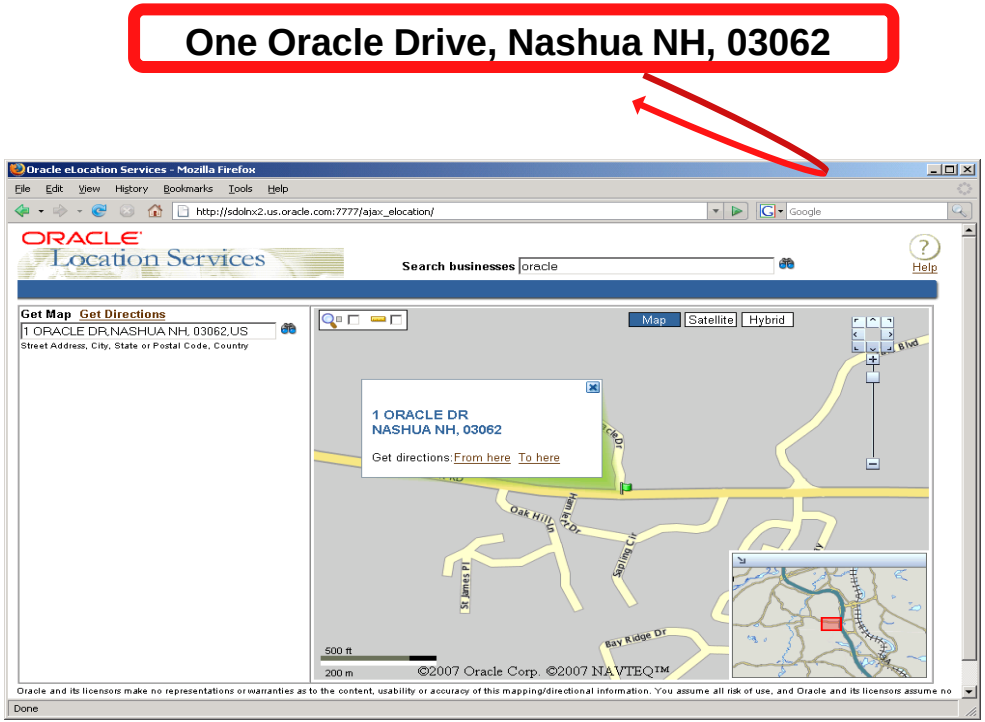
Geocode:

- 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



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Analyze: Geospatial Data

Find all competitors within 2 miles of Northport Branch

```
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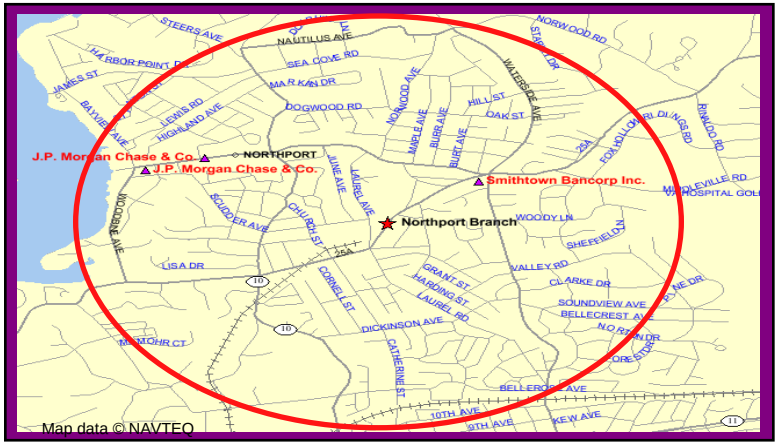

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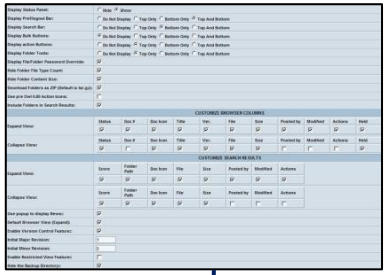
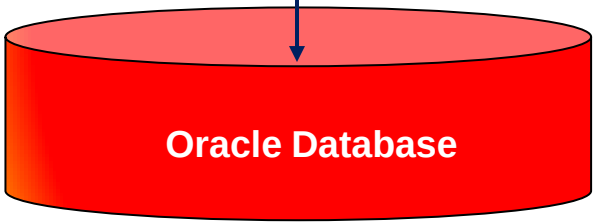
Native Spatial Analyses

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;
```



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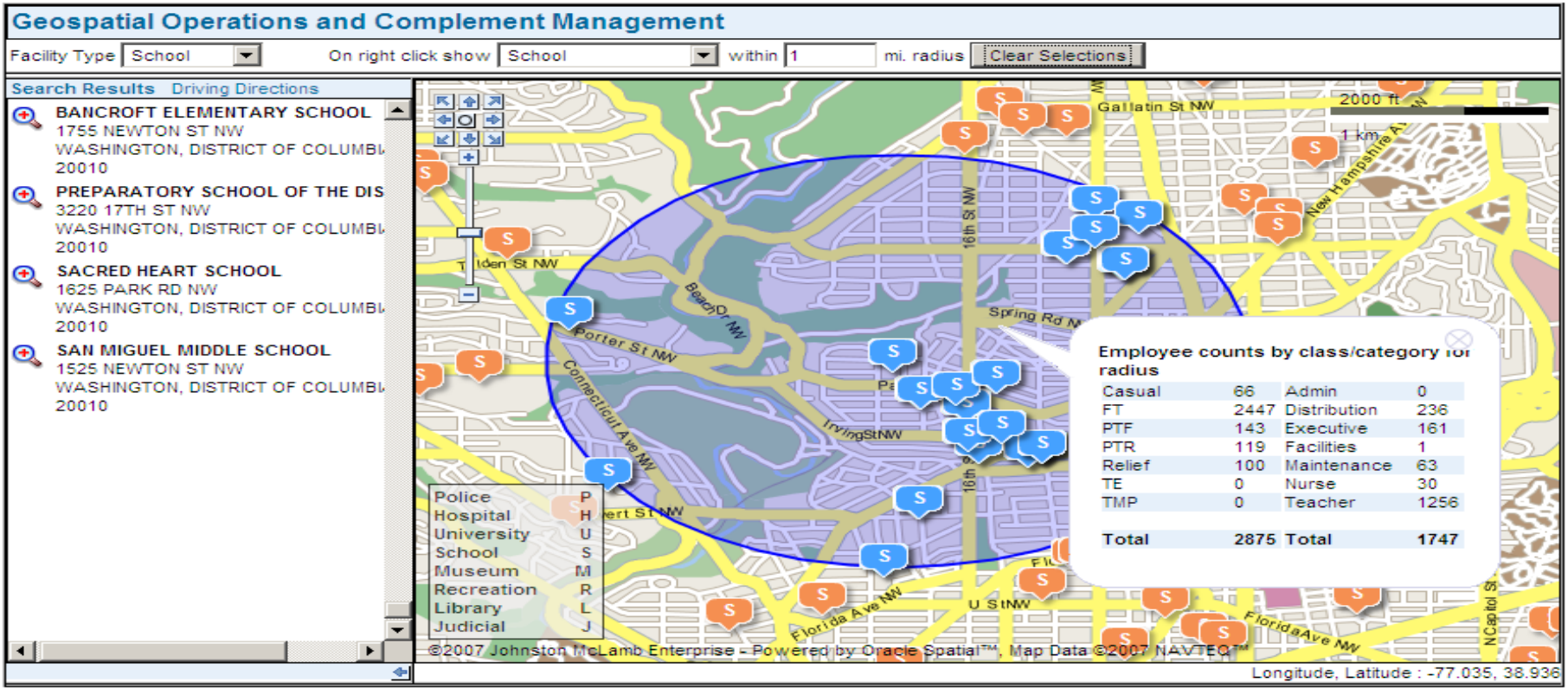
Display: Generate Powerful Maps



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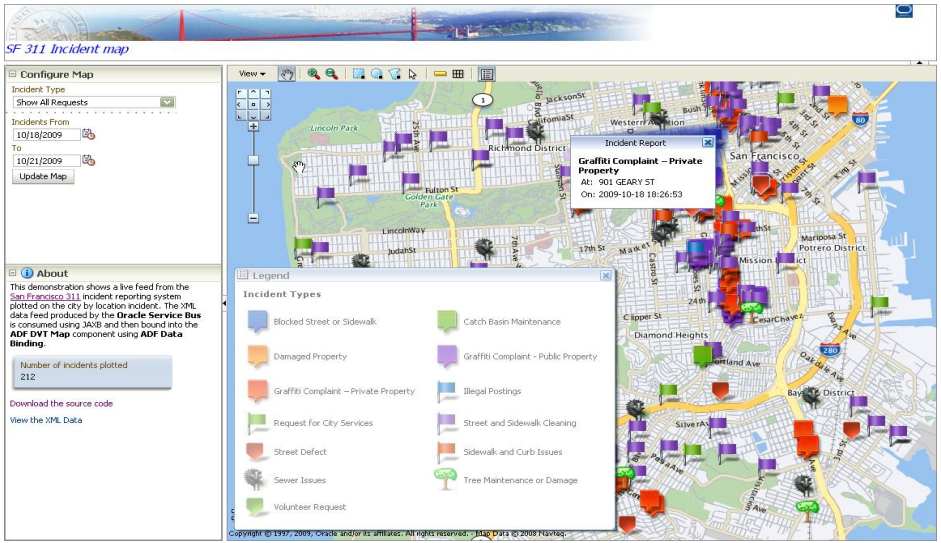
Oracle Fusion Middleware MapViewer

- 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



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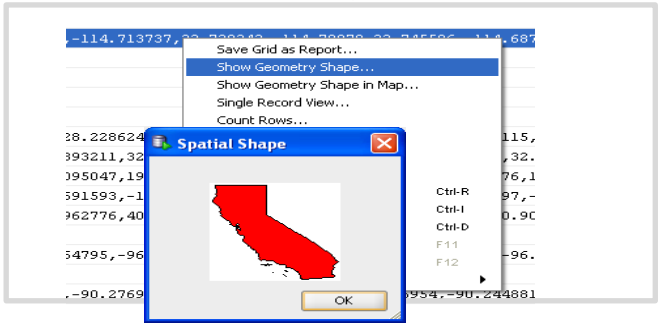
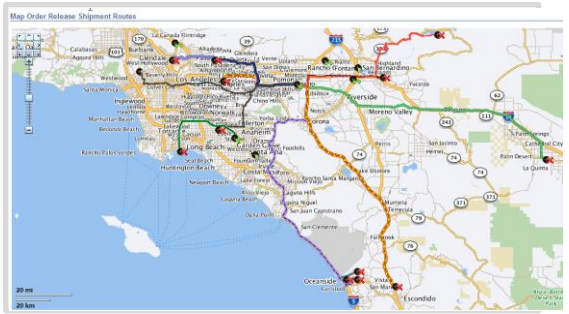
Spatial Analysis and Maps in Oracle Applications, Tools and BI

Oracle BI 11g Mobile

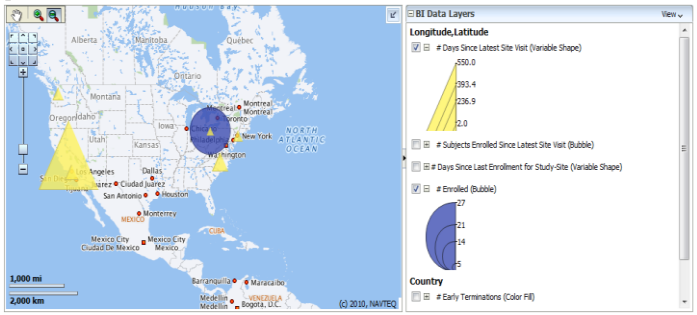
Oracle SQL Developer



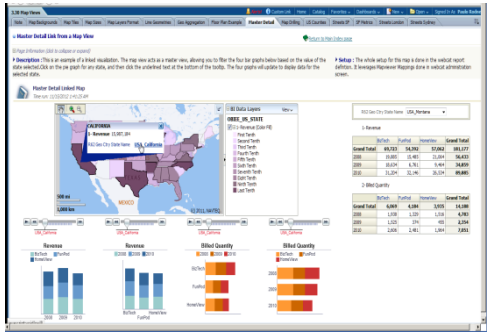
Oracle Fusion Business Suite: Oracle Transportation Manager



Health Sciences



OBIEE Map View



Utilities Outage Management

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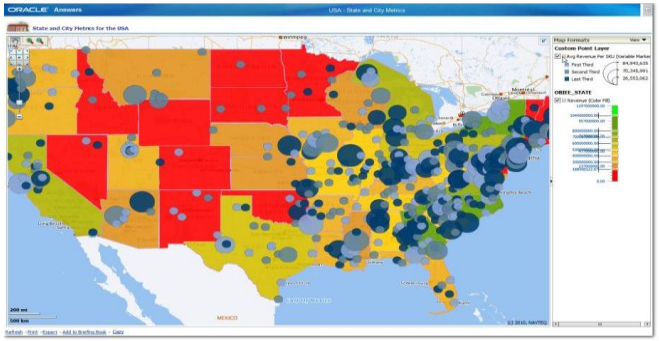
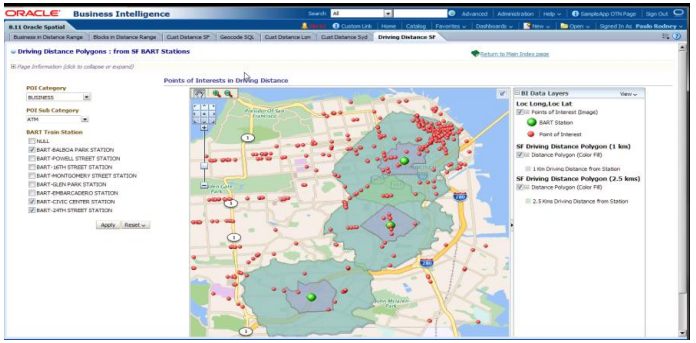


Demo



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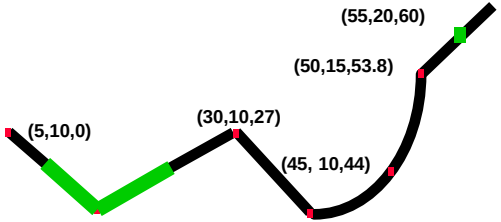
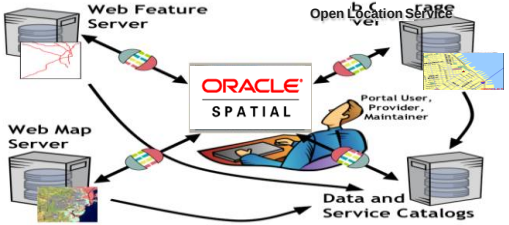
Many More Rich Features – the Most Advanced Geospatial Database Platform

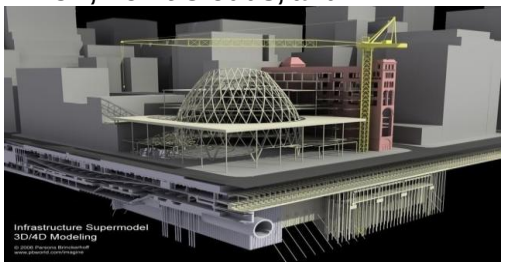
Linear Referencing



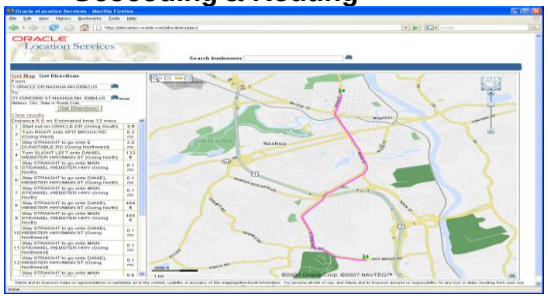
Spatial Web Services



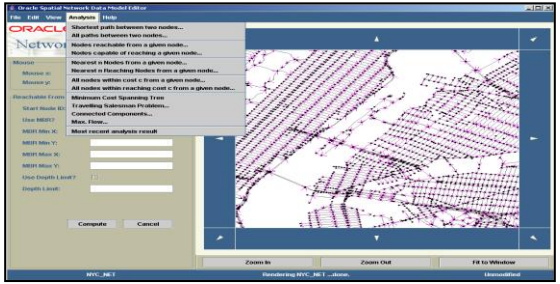
3D, Point Clouds, and LIDAR



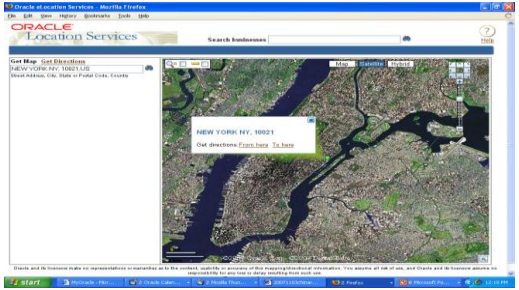
Geocoding & Routing



Planar Networks



Raster Imagery



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Advances with Oracle Database 12c

Spatial Features

Dramatic Performance

Simplified Application Development

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Oracle Spatial and Graph

Dramatic Performance and Simplified Application Development

ORACLE® DATABASE 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

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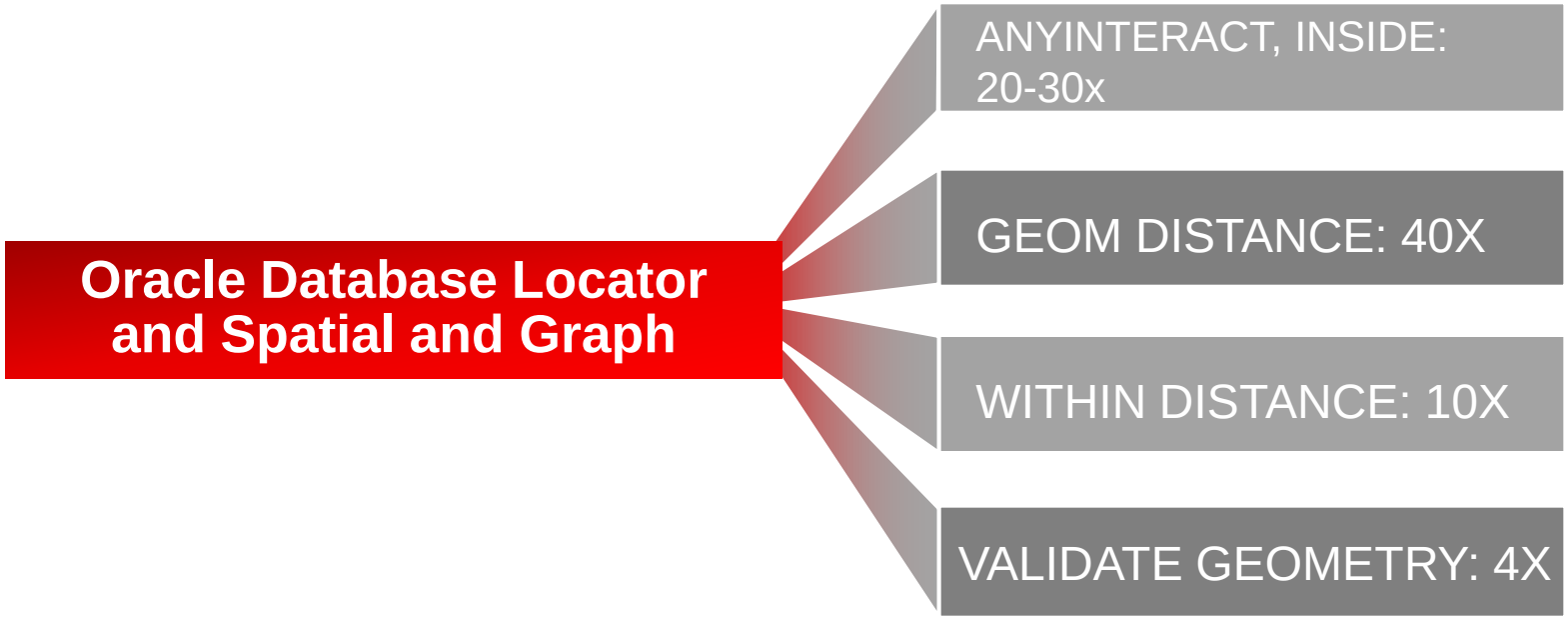
Dramatically Improved performance

Core Spatial Functions and Operations



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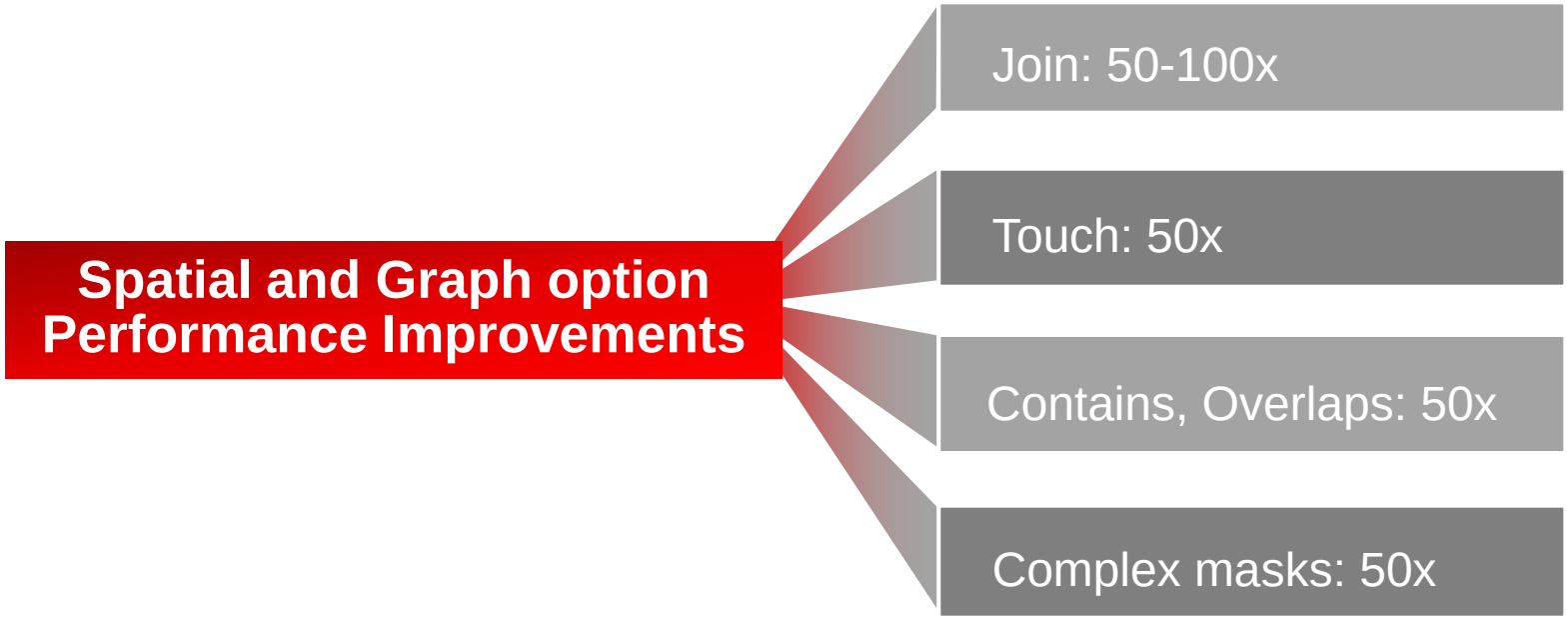
Vector Performance Acceleration

“Turbo-charged” spatial functions and operators



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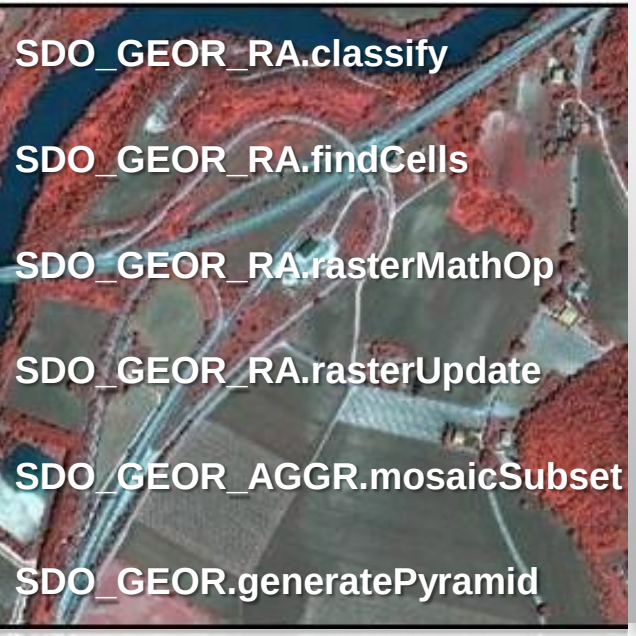
Parallel Raster Operations



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

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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

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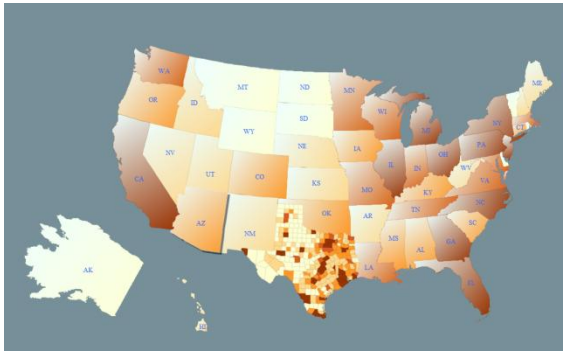
Oracle MapViewer – 11.1.1.7 Capabilities

- 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



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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

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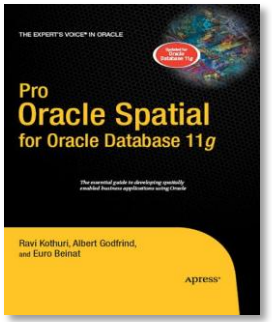
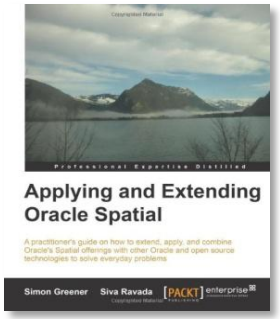
Suggested Reading Material

- Pro Oracle Spatial, Ravi Kothuri, Albert Godfrind, Euro Beinat, Apress, 2007
  - ISBN 978-1-59059-899-3



- Applying and Extending Oracle Spatial, Simon Greener, Siva Ravada, Packt Publishing, 2013
  - ISBN 184968636X



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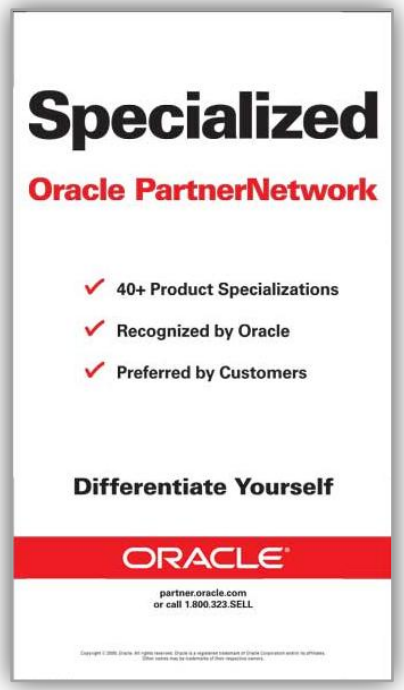
Partner Specialization & Individual Certification

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
- www.oracle.com/technetwork/database/options/spatialandgraph/learnmore/spatial-partners-423197.html



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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

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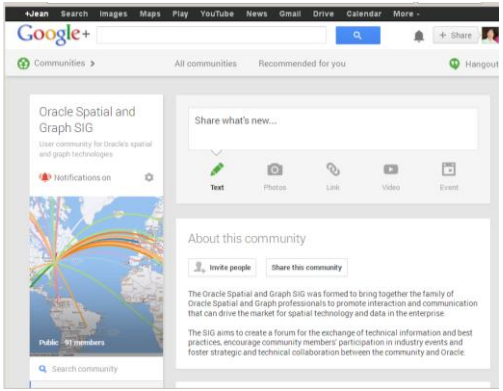
Communities

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**
  Search online for **"Oracle Spatial and Graph Community"**
- Email **jean.ihm@oracle.com** and Keith Bingham – SIG Membership Chair at **oraclespatialsig@gmail.com**

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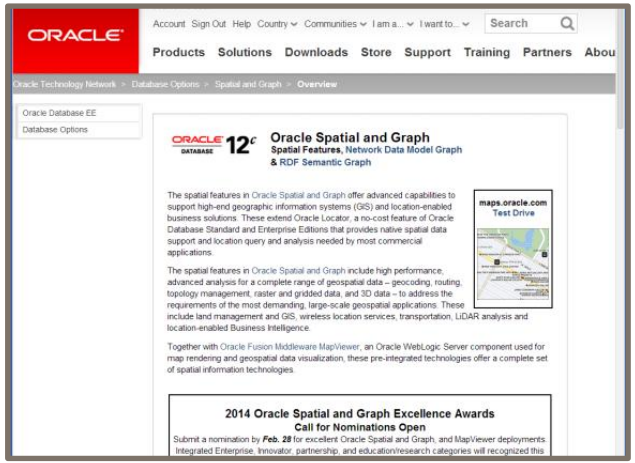
Resources at Oracle Technology Network

- **Oracle Spatial and Graph:** www.oracle.com/technetwork/database/options/spatialandgraph/
- **Oracle MapViewer:** www.oracle.com/technetwork/middleware/mapviewer/



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

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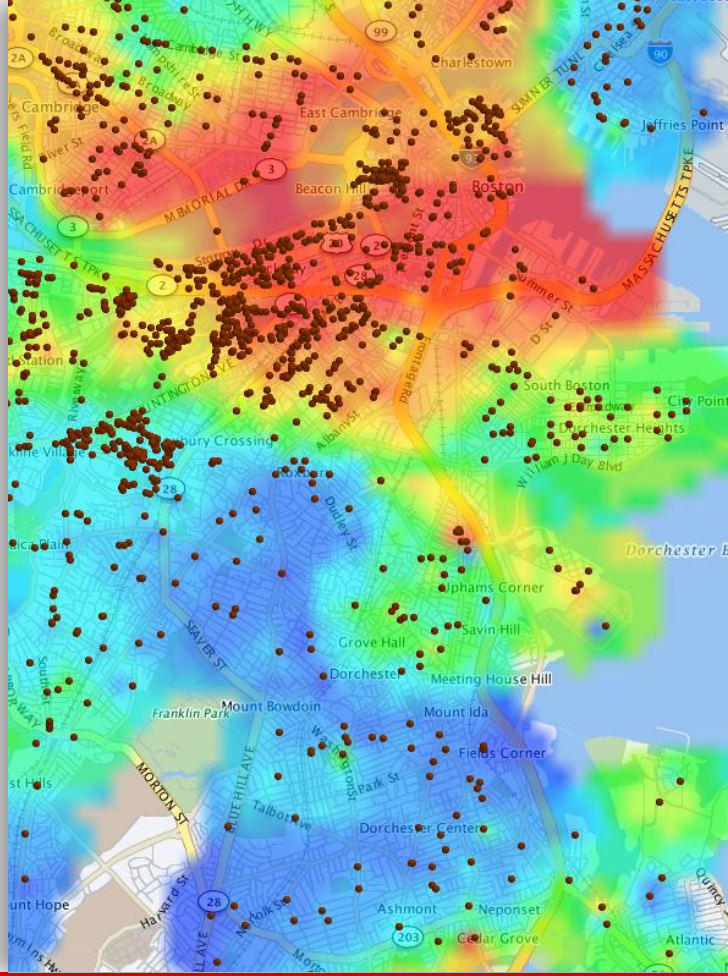
Q & A



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