

Oracle Spatial 10g

*An Oracle White Paper
August 2005*

INTRODUCTION

Oracle Spatial, an option for Oracle Database 10g Enterprise Edition, includes advanced spatial capabilities to support GIS applications, location-based services, and enterprise spatial information systems. Oracle Spatial extends the core location features included in every Oracle database with Oracle Locator.¹ Its advanced data manipulation and spatial analysis features include buffer generation, spatial aggregates, area and length calculations, and linear referencing. The first release of Oracle Spatial 10g introduced a GeoRaster datatype to store and manage image and gridded raster data and metadata, network and topology data models, geocoding and routing engines, and spatial analysis and mining functions. These significant new capabilities address business-critical requirements of the public sector, defense, logistics, energy exploration, business geographics, and life sciences domains. The second release of Oracle Spatial 10g introduces eLocation Quick Start, a set of Java APIs for quick and easy deployment of mapping, geocoding, and routing services, and enhances features introduced in the first release. Combined with the performance, scalability, and security of Oracle Database 10g, Oracle Spatial 10g is the most advanced spatial database platform available for enterprise class deployments.

In general, this white paper describes those features included only with Oracle Spatial, but does not cover Oracle Locator features in depth.²

SPATIAL FUNCTIONS

Oracle Spatial provides functions that perform calculations on geometries, such as area of a polygon and length or perimeter of a

¹ Oracle Locator, a feature of Oracle Database 10g (Standard Edition, Standard Edition One, and Enterprise Edition), provides core spatial features for business applications and partner-based GIS. Features include vector data storage and management, indexing, spatial relationship analysis, coordinate systems support (including support for the EPSG model), and more.

² For descriptions of features in Oracle Locator, please refer to *Oracle Locator: Location-Enabling Every Oracle Database - Technical White Paper* and *Oracle Spatial Option and Oracle Locator - Data Sheet*. For complete, detailed listings of Oracle Locator and Oracle Spatial features, please refer to Appendix B of the *Oracle Spatial User's Guide and Reference 10g Release 2(10.2)*.

geometry. These functions can be used, for example, to determine the total area of all counties around Passaic County, length of an interstate highway, or length of a state border.

Oracle Spatial functions can also generate new geometries such as buffers, unions, intersections, and more. They can be used, for example, to define sales regions by creating a 5 mile buffer around all sales offices, find the geometry representing the union of two sales regions, or find the intersection between two sales regions.

WHOLE EARTH GEOMETRY MODEL FOR GEODETIC COORDINATE SUPPORT

A whole Earth geometry model takes into account the curvature of the Earth's surface when performing calculations on geodetic data. Thus, Oracle Spatial functions return accurate lengths and areas for both projected and geodetic data. Oracle supports over 30 of the most commonly used distance and area units, e.g. foot/square foot, meter/square meter, kilometer/square kilometer, and so on.

LINEAR REFERENCING SUPPORT

Oracle Spatial supports the storage of "measurement" information associated with a linear geometry. This allows many attributes or events to be associated with a specified segment on a linear geometry.

Attributes or events are stored in tables separately from the geometry, and the geometry does not have to be duplicated in the attribute tables. Linear referencing is often used by departments of transportation, to model roads or railroads and their attributes; utilities, to model oil or gas pipes and their attributes; and telecommunications providers.

Functions to manipulate linear referenced geometries are also included, e.g. clipping a piece of a linear feature, concatenating a linear feature, and splitting a linear feature.

SPATIAL AGGREGATES

SQL has long had aggregate functions, which are used to aggregate the results of a SQL query. Spatial aggregate functions operate on a set of geometries rather than just one or two geometries. An aggregate function performs a specified aggregate operation on a set of input geometries, and returns a single geometry object. For example, the following statement returns the state boundary of Tennessee generated from all of the counties in Tennessee:

```
select sdo_aggr_union(sdoaggrtype(geom,0.5)) state
from geod_counties
where state_abrv='TN';
```

Other supported aggregate functions include union, centroid, and convex hull; users can also define other aggregate functions. The use of spatial aggregates improves performance and simplifies coding.

GEORASTER SUPPORT (ENHANCED FOR 10G RELEASE 2)

Oracle Spatial includes a data type that natively manages georeferenced raster imagery (satellite imagery, remotely sensed data, gridded data) in Oracle Database 10g. The GeoRaster feature of Oracle Spatial provides georeferencing of imagery; XML schema for metadata management; and basic operations like pyramiding, tiling, and interleaving. Applications in environmental management, defense/homeland security, energy exploration, and satellite image portals will all benefit from this powerful functionality.

New in 10g Release 2: GeoRaster now supports industry standard compression techniques for raster (image and cell-based, or "grid") data, including the JPEG baseline (lossy) and DEFLATE (lossless) standards. Other proprietary compression techniques are supported through third party plugins. All GeoRaster functions that can be performed on uncompressed GeoRaster objects can be performed on compressed objects. Remote sensing imagery results in very large data sets, growing at the rate of a terabyte or more per day. The capability to store and manage these images in compressed form is a key requirement for users and DBAs alike. Customers save money on storage costs when image sizes are reduced by up to 80 percent. This is essential for defense/security, agricultural, and environmental monitoring applications.

For more information about GeoRaster, please refer to separate white papers at www.oracle.com/technology/products/spatial.

NETWORK DATA MODEL (ENHANCED FOR 10G RELEASE 2)

A data model is provided to store network (graph) structure in Oracle Database 10g. It explicitly stores and maintains connectivity of link-node networks and provides network analysis capability such as shortest path and connectivity analysis. Applications requiring network solutions include transportation, transit, utilities and life sciences (biochemical pathway analysis).

New in 10g Release 2: The network data model now includes: a PL/SQL interface for creating, editing, and analyzing network data; a data modeling enhancement for specifying bidirected links; a function to find the maximum allowable flow from a source to a sink node; the ability to create and apply network constraints; and the ability to specify costs by a PL/SQL function.

For more information about Oracle Spatial network data model, please refer to separate white papers at www.oracle.com/technology/products/spatial.

TOPOLOGY DATA MODEL (ENHANCED FOR 10G RELEASE 2)

Oracle Spatial includes a data model and schema that persistently store topology in the Oracle Database. This is useful when there is a high degree of feature editing and a strong requirement for data integrity across maps and map layers. Another benefit is that topology-based queries typically perform faster for queries involving relationships such as adjacency, connectivity, and containment. Land management (cadastral) systems and spatial data providers benefit from these capabilities.

New in 10g Release 2: Feature level spatial transactions against persistent topology in the database are now supported. In the previous release, multiple operations were required to insert or update all of the node, edge, and face elements of a feature; now, a feature insert or update occurs as a single operation. This dramatically simplifies the process of updating and maintaining topology datasets, and reduces the code required.

The process for exporting a topology and importing it into a target database has been simplified. New operators, functions, and subprograms make the topology data model even more flexible and easy to use.

SPATIAL ANALYTIC FUNCTIONS (INTRODUCED IN 10G RELEASE 1)

Server-based spatial analysis capabilities include classification, binning, association, and spatial correlation – essential for business intelligence applications.

For more information about spatial analytic functions, please refer to a separate white paper at www.oracle.com/technology/products/spatial.

GEOCODER (ENHANCED FOR 10G RELEASE 2)

Geocoding is the process of associating geographic references, such as addresses and postal codes, with location coordinates (longitude and latitude). With the Oracle Spatial option of Oracle Database 10g, a fully functional geocoding engine is provided. It provides international address standardization, geocoding and POI matching by querying geocoded data stored in Oracle Database. Its unique unparsed address support adds great flexibility and convenience to customer applications. A PL/SQL API for geocoding is provided.

New in 10g Release 2: The geocoding engine now supports reverse geocoding, batch geocoding, and other new geocoding subprograms.

ROUTING ENGINE (ENHANCED FOR 10G RELEASE 2)

A scalable routing engine provides driving distances, times, and directions between addresses (or locations that have been geocoded in advance). It is provided as a Java client library that can be easily deployed in either Oracle Application Server or standalone OC4J environments. Other features include: preference for either fastest or shortest routes, returning summary or detailed driving directions, and returning the time and distance along a street network from a single location to multiple destinations.

New in 10g Release 2: The Spatial routing engine has now been extended to provide driving distances, times, and directions between addresses for over a dozen Western European countries, including Germany, United Kingdom, France, and more. These enhancements enable logistics, transportation, and location-based services applications to build driving directions services for these countries.

eLOCATION QUICK START (NEW WITH 10G RELEASE 2)

Oracle Spatial 10g Release 2 introduces eLocation Quick Start. Location service Java and XML APIs enable application developers to quickly and easily deploy mapping, geocoding, and routing services right "out of the box", from data stored in Oracle Spatial. The APIs ship with sample HTML interfaces to jump-start the creation of driving directions, mapping, and geocoding applications. The Oracle Spatial geocoding and routing APIs may be used by Oracle Application Server MapViewer, many third party mapping tools, or user-developed applications.

Sample data is available online. Data sets in the format supporting Oracle Spatial 10g are also available from leading data providers. Visit www.oracle.com/technology/products/spatial/ for more information.

OPEN STANDARDS

Oracle consistently works to help shape, drive, implement and support the latest open standards in the spatial and location services areas. Oracle is a Principal Member of the Open Geospatial Consortium (OGC) and participates actively on the Technical Committee. Oracle Spatial 10g Release 1 (10.1.0.4) complies with the OpenGIS Simple Features Specification for SQL, Revision 1.1, Types and Functions Alternative. Oracle is also committed to supporting the new OGC Geographic Markup Language (GML) as well as Open Location Service interfaces. The object-relational model used for geometry storage by Oracle Spatial also conforms to the specifications associated with SQL92 representation of points, lines, and polygons.

SUPPORT FROM LEADING GIS AND LOCATION SERVICES VENDORS

Oracle Spatial is directly integrated with the leading GIS and location services technology vendors. The breadth of partner support provides developers with their choice of best of breed tools to meet their requirements. With Oracle Spatial 10g and partner tools, developers can rapidly deploy scalable, secure enterprise GIS and location service solutions.

A list of partners is available at www.oracle.com/technology/products/spatial (click “Partners”, under “Quick Picks”).

CONCLUSION

The Oracle Spatial option provides advanced spatial capabilities for Oracle Database 10g, addressing the business-critical needs of customers in traditional GIS domains such as defense, homeland security, land management, transportation, as well as new areas such as life sciences.

Oracle Spatial with Oracle Database Enterprise Edition is the solution for users who have GIS applications requiring advanced server-side spatial analysis and processing. The first release of Oracle Spatial 10g introduced significant new features. An open GeoRaster format supports the image storage and management requirements from the public sector, defense, and energy exploration domains. Network and topology data models meet the needs of applications in transportation, utilities, land management, life sciences, and location services. A server-side geocoder and routing engine support the deployment of location-based services, and spatial analysis functions enhance business applications. The second release of Oracle Spatial 10g continues to enhance these capabilities, and introduces an eLocation Quick Start feature for quick and easy deployment of mapping, geocoding, and routing services.

Oracle holds an 80-90% share of the geospatial database management market (IDC, *Oracle 10g: Spatial Capabilities for Enterprise Solutions*, Sonnen and Morris, Feb. 2005). Customers and partners rely on Oracle to deliver performance, scalability, security, and ease of use for their spatial applications. Oracle Spatial is supported by all the leading GIS and location services vendors. Oracle Spatial 10g provides the most advanced spatial capabilities available in a relational database management system today, and the unmatched enterprise data management capabilities of Oracle Database 10g – making it the leading geospatial database management platform for GIS and enterprise spatial systems.



Oracle Spatial 10g

August 2005

Authors: Jean Ihm, Xavier Lopez

Contributing Authors: Jim Steiner, Siva Ravada, Dan Abugov, Jayant Sharma

Oracle Corporation

World Headquarters

500 Oracle Parkway

Redwood Shores, CA 94065

U.S.A.

Worldwide Inquiries:

Phone: +1.650.506.7000

Fax: +1.650.506.7200

oracle.com

Copyright © 2005, Oracle. All rights reserved.

This document is provided for information purposes only and the contents hereof are subject to change without notice.

This document is not warranted to be error-free, nor subject to any other warranties or conditions, whether expressed orally or implied in law, including implied warranties and conditions of merchantability or fitness for a particular purpose. We specifically disclaim any liability with respect to this document and no contractual obligations are formed either directly or indirectly by this document. This document may not be reproduced or transmitted in any form or by any means, electronic or mechanical, for any purpose, without our prior written permission. Oracle, JD Edwards, and PeopleSoft are registered trademarks of Oracle Corporation and/or its affiliates.

OGC, OpenGIS®, and CERTIFIED OGC COMPLIANT are trademarks or registered trademarks of Open Geospatial Consortium, Inc. in the United States and in other countries. Other names may be trademarks of their respective owners.