

# Spatial Technology in Oracle Database

Oracle provides innovative, robust spatial features in a multi-model, multi-workload, multi-tenant converged database. With no-code location analytics and visualization it is easier than ever to get started. Developers, database professionals and analysts have a flexible platform for location-enabled business and mapping services and advanced geospatial systems.

Oracle has comprehensive data types, models, services, and tools for spatial data management, analytics, and visualization. The spatial features benefit from Oracle Database enterprise scalability, security, and performance. Organizations worldwide rely on Oracle to handle their most demanding, mission-critical spatial requirements.

## Location Analysis

Oracle's mission is to help people see data in new ways, discover insights, and unlock endless possibilities. Location analysis is about understanding complex interactions based on geographic relationships – answering questions based on where people, assets, and resources are located. Spatial insights enable you to provide better customer service, optimize your workforce, locate retail and distribution centers, evaluate sales and marketing campaigns, and more.

With Oracle's spatial offerings, developers, database professionals, and analysts can use a comprehensive suite of spatial data management, analytics, and visualization tools to integrate spatial analysis and mapping into applications on enterprise grade data management infrastructure – Oracle Database and Oracle Exadata. Innovative technologies in Oracle Cloud and Oracle Autonomous Database, the industry's only self-driving, self-securing, and self-repairing database, are available to spatial applications.

## Spatial Features

Oracle Database includes advanced spatial analysis and processing. It supports all major spatial data types and models, addressing business-critical requirements from many industries, including transportation, utilities, energy, public sector, defense and commercial location intelligence.



## Comprehensive Spatial, Mapping, and Location Analytics Platform

- Oracle spatial technology is an integral part of Oracle Database. The spatial features are included in all editions of Oracle Database, database cloud services, and Autonomous Database without additional licensing cost.

## Key Benefits

- Oracle Database scalability, security and manageability for enterprise spatial applications
- Engineered Systems
- Self-service map visualization and creation of analytic workflows geared towards non-experts
- Native storage, management, and analysis of all major geospatial data types and models
- Supported by all leading geospatial vendors and open source components

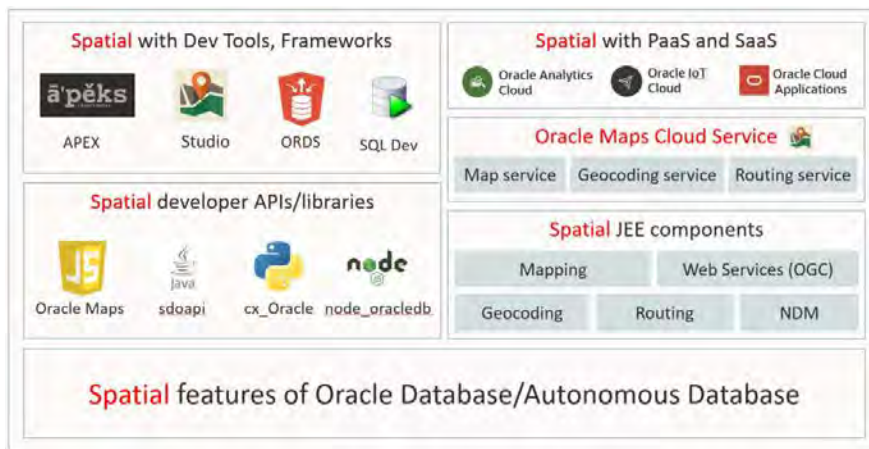


Figure 1: Spatial Analytics and Cloud Service Platform

### Data model and comprehensive analytics for 2D spatial data

You can perform queries based on proximity (how near or far something may be) and containment (whether something is within or outside a given region). Hundreds of functions and operations to filter data, measure distance relationships, and combine and/or transform geometries are provided.

### 3D point clouds and LiDAR

These features manage spatial sensor data used for enterprise 3D GIS and Smart City applications. The 3D support is optimized for point cloud and CityGML workflows. They enable the production and management of seamless 3D point cloud models ranging from small local areas, to large cities and countries.

### Spatial Studio for easy spatial application development

This web application is a self-service, visual, no-code map canvas and spatial analysis tool. Analysts using Oracle Database and Autonomous Database can now perform spatial analysis and mapping without writing a line of code and can incorporate code in applications, make results available to REST services, publish the results as web pages, or hand them off to Oracle Analytics Cloud.

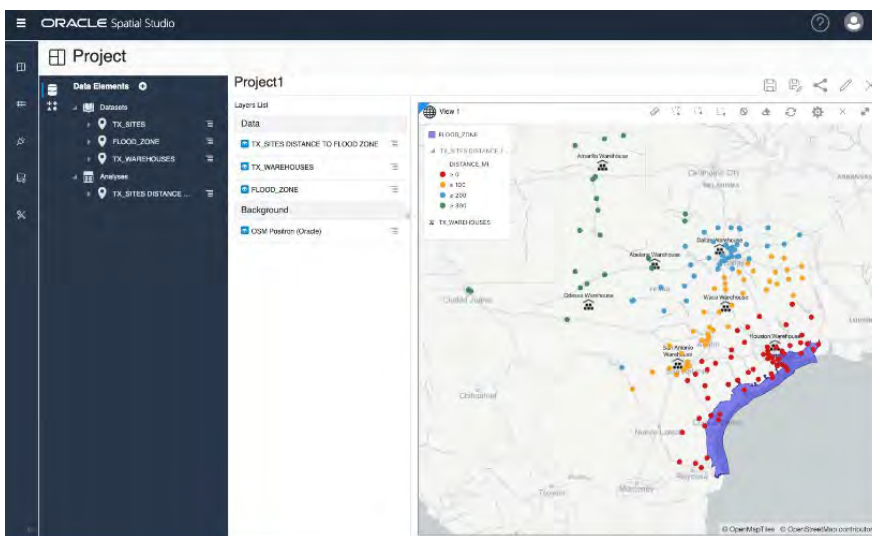


Figure 2: Screenshot of Oracle Spatial Studio

### Key Spatial Features

- Spatial object type for vector data, spatial index type, hundreds of spatial operators and functions
- Comprehensive support for coordinate systems and transformations
- GeoRaster support for geo-referenced imagery and gridded data
- 3D data model – native support for 3D geometries, surfaces and LiDAR point clouds.
- Support for OGC and ISO geospatial standards – Web Feature Service, Web Map Service/Tile Service, Web Coverage Service, Web Catalog Service
- Geocoding and routing engines
- Topology data model; linear referencing system
- Network Data Model to represent graphs and networks in link and node tables
- JSON support for spatial data access, REST APIs
- Location data enrichment API with geographic hierarchy and place names data set
- Spatial index and partitioning
- Map visualization of geographic data
- Location tracking server

## **Spatial support for partitioning, in-memory, distributed transactions and sharding**

Spatial applications can now leverage these database features used for high performance on large data sets, in large scale web and cloud-based applications, and for massively scalable and reliable OLTP applications.

## **Standards based SQL, Java APIs, native JSON, and REST**

Developers can easily add spatial capabilities to applications using modern application frameworks of their choice, without having to learn new languages. Spatial data can be read using standard interfaces and published on the web using standard formats.

## **Support for OGC web services**

Oracle Database includes standard Open Geospatial Consortium web services to publish spatial data and interoperate with wide range of commercial, open source, or custom data sources and applications.

## **Map visualization component**

Using HTML5 and WebGL-based JavaScript APIs, developers can incorporate highly interactive maps and spatial analysis into business applications. Application content can be combined with maps and data from a variety of web services and data formats. This map visualization component is deployed in a Java EE container.

## **Geocoding and Reverse Geocoding**

Geocoding is a fundamental process that helps organizations refine and enrich existing address and location information found in relational tables. It generates latitude/longitude from existing customer addresses (or site locations) and is usually the first step in location intelligence applications.

## **Network Data Model and Routing Engine**

Network Data Model lets you model physical and logical networks and real-world features with a geographic component. Typically, it is used to represent road, transportation, telecommunications, utility, energy and other networks so you can analyze them for shortest path, nearest neighbors, within cost and reachability. The networks can be partitioned and loaded into memory on demand to enable scalable in-memory analysis of very large networks.

A routing engine, based on the Network Data Model, provides driving directions along street networks, and can incorporate data feeds such as traffic patterns.

## **GeoRaster**

Oracle Database stores and processes geo-referenced raster data, such as satellite imagery and gridded data. It provides a powerful raster algebra library and supports the creation of virtual mosaics. GeoRaster has an integrated loading tool to load and export raster data. It supports on the fly image processing and analytics for real time applications. GeoRaster is used in energy, natural resource management, and national security applications.

## **New Spatial Features**

- Spatial Studio – self-service, visual, no code map canvas and spatial analysis tool
- Spatial support for In-memory Option
- Spatial support for distributed transactions
- Spatial support for database sharding
- Contact tracing APIs
- High-performance routing for static networks based on pre-computed graph
- Improved web services user interface, CSW and WFS enhancements
- Server-side raster loading tool, more image processing and analytics functions

## **Related Products**

- Oracle Database
- Oracle Autonomous Database
- Oracle Analytics Cloud Service
- Oracle Advanced Analytics
- Oracle Big Data Spatial and Graph
- Oracle Exadata Database Machine.

## Topology data model

Topology is used by mapping and land management organizations that require a high degree of feature editing and data integrity across their maps and map layers.

## Location data enrichment services

The enrichment process associates authoritative location terms (place names, addresses, and latitude / longitude) to text found in database tables. They allow for better joining and integration of locations with other data in the database or streaming services to perform spatial and text analysis.

## Location tracking server and contact tracing APIs

The location tracking server supports tracking millions of moving objects against thousands of regions of interest in the database, for logistics and IOT applications. Location of moving objects can also be analyzed for pair-wise interactions for the purpose of contact tracing using a scalable, automatic API.

## The World's Leading Platform for Spatial Data

Oracle's spatial features are a native part of Oracle's converged database – and of the world's leading information technology platform for Oracle Cloud, on premises, and big data deployments. Developers can easily incorporate these capabilities in their solutions using modern development frameworks. Spatial applications developed with Oracle benefit from the leading performance, scalability and security capabilities of Oracle Database. They can exploit the extreme processing power and bandwidth of Oracle Exadata Database Machine. Oracle tools and enterprise applications, and leading vendors support Oracle's spatial features. The largest enterprises worldwide – mapping agencies, transportation, utilities, telcos, insurance, energy, financial services and more – rely on Oracle for their spatial processing needs.

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