



# ORACLE SPATIAL

## Introduction

Oracle supplies a complete information processing solution comprising:

- A database management system (DBMS): this system programme manages data, enabling storing and sharing of information in a database while ensuring the quality, sustainability and confidentiality of the information and hiding the complexity of the operations;
- The Oracle Fusion Middleware application server: this programme deploys applications. It occupies the central layer in a classic three-tiered architecture (workstations, application server, database) and hosts applications so as to execute them from a workstation. In addition, it supplies a middleware<sup>1</sup> service for security, state maintenance, access to data and data sustainability.

**Apart from traditional information, this solution manages all the geographical information and is the most advanced spatial data platform available on the market.**

This platform comprises three modules:

- Oracle Locator: this is a standard module, present in all Oracle databases. It supplies the basic mapping features of a number of management applications and geo-spatial solutions;
- Oracle Spatial: this extends the scope of the Oracle Locator module, adding advanced features for more complex geo-spatial applications (geocoding, routing, raster data, network modelling, topology etc);
- Oracle MapViewer: this is an online mapping server (intranet, internet) present in the Oracle Fusion Middleware application server. Hence it is used to produce maps in a "web" environment using spatial data specially stored in the database, and to share geo-referenced information via internet.

The database comes in three editions:

- Oracle Database Express Edition (XE) (free) ;
- Oracle Database Standard Edition ;
- Oracle Database Enterprise Edition.

The Oracle Locator module is present in all editions of Oracle Database. However, Oracle Spatial is a premium option available only with the Oracle Database Enterprise Edition licence.

<sup>1</sup>Un middleware is a third party program which creates an information exchange network between various applications.

The application server comes in two versions:

- WebLogic Server Standard Edition ;
- WebLogic Server Enterprise Edition.

Both include the Oracle MapViewer module.

## 1. Oracle Locator

Oracle Locator is a module of Oracle Database 11g offering sufficient characteristics and features to respond to the basic needs of a number of management applications and geo-spatial solutions. It is the heart of Oracle Spatial and permits storage of geometrical forms (dots, lines, polygons, 2D and 2,5D<sup>2</sup>), their spatial indexing and their use by simple spatial queries (spatial analyses, buffer, transformation etc). In addition, Oracle Locator manages and transforms coordinate systems.

Oracle Locator defines a particular type of data known as SDO\_GEOMETRY, as well as standard types such as NUMBER and VARCHAR2, enabling storage of the geometry of objects. This type can be used by all GIS editors and allows data to be interoperable between them:

- Storage ;
- Indexing;
- Processing and analysis:
  - Topological queries;
  - Distance;
  - Proximity;
  - Various tools.
- Management of coordinates systems.

## 2. The Oracle Spatial option

Oracle Spatial is an option of Oracle Database 11g Enterprise Edition which extends the scope of Oracle Locator. The option not only manages information with spatial references; it also adds advanced features in existing GIS applications, including:

- **Geocoder:** to transform an address into geographical coordinates and *vice versa*;
- **Router:** to calculate an itinerary between 2 addresses;
- **Georaster:** to store satellite and raster images in the database;
- **Network data model:** to manipulate networks for chart routes (Isochrone, "Commercial Traveller's Problem" etc);
- **Topological data model :** to store geometrical entities in topological form in order to preserve the continuity and adjacency of the data;
- **Web services:** WFS<sup>3</sup>, CSW<sup>4</sup>, LBS<sup>5</sup>, etc. These services grant standard access to the data from various external applications;
- **Complex queries:** Data mining, spatial aggregations etc;

<sup>2</sup> Oracle Locator can store Z, but only the execution of 2D queries is allowed

<sup>3</sup> Web Feature Services

<sup>4</sup> Catalog Services for the Web

<sup>5</sup> Location Based Services

- **Solid 3D:** for storage and management 3D<sup>6</sup>;
- **LRS (Linear Referencing System/Dynamic segmentation):** to store events along a linear object (road network, electrical lines, pipes etc). In this case, 2D+measure or 3D+measure objects will be used;
- **MNT and cloud points:** for optimal storing of digital terrain models (via SDO\_TIN) and cloud points from ie LIDAR (via SDO\_PC).

Oracle Spatial 11g is aimed at two types of users. On one hand, it targets users of the Oracle database via enhancement of their applications by adding queries exploiting the spatial dimension of their data. On the other, it targets GIS users by allowing them to take advantage of the power of Oracle (storage, search and organisation of data), which facilitates management of terabytes of geo-referenced data.

### 3. Oracle MapViewer

Oracle MapViewer is a Middle Tier application deployed in the Oracle Fusion Middleware application server.

This is a mapping restitution server for producing thematic maps in a web environment, or on autonomous applications, by using spatial data stored and managed by the Oracle database. It performs transparent queries via jdbc and returns the results in the form of mapping accompanied by restitution metadata and any attribute data linked to the geographical data.

Oracle MapViewer also includes an administration interface and a complete toolbox for developers, including various APIs (Application Programming Interfaces) ie an XML API, Java, PL/SQL and Javascript (AJAX).

The XML API allows direct interrogation of the application server via an XML queries to generate a static map corresponding to the definition of the latter.

The Java and PL/SQL APIs allow development of custom applications (in Java – JSP, Applet etc – or any other language) integrating dynamic maps.

The AJAX API (Oracle Maps) facilitates the development of completely interactive web applications. Apart from dynamic restitution of the data, and cutting edge mechanisms of optimisation, such as automatic cache management or tile generation, this API offers various features that can be configured to interact in real time with data via the navigator's custom application ie:

- Navigation tools;
- Menu creation tools;
- Restitution configuration tools;
- Measurement calculation tools;
- Drawing tools;
- Attribute processing tools;
- Customisation tools;
- ...

<sup>6</sup> The Spatial Option can store volumes and multi-faced 3D objects, and execute 3D queries.

Plus more advanced features for users with more specialised needs (business intelligence, analysis etc), such as:

- Integration of chart elements directly on the map (pie charts, histograms etc);
- Dynamic updating of restitution of the maps according to the attribute values;
- Use of advanced restitutions (hatching, gradation etc);
- Integration of symbols on the map;
- ...

Oracle MapViewer is therefore a complete solution when restoring geo-spatial data stored in the Oracle database. It supports 2D vector, raster, network and topographical data, and various image formats (PNG, GIF, JPEG, SVG etc) and meets OGC standards, so it can be used as a complete mapping server including standard GIS protocols such as WMS.

## 4. Why use ORACLE?

### SINGLE DATABASE

The world of GIS is developing rapidly, and it is becoming increasingly important to share and manipulate geo-spatial information, and make it accessible to the greatest possible number of people. Geo-spatial information is now everywhere and is used in numerous fields such as the cadastre, geo-marketing, management of customer relations, vehicle tracking and environmental management. The volume of geo-spatial data, and the number of users are constantly growing. The performance of file management systems, access controls, updates, etc for classical files is therefore becoming limited.

This is why Oracle Spatial 11g allows the use of a single repository for spatial and attribute data. This gives access to openness, scalability, security and performance. By storing all geo-spatial information in a single database, reliability and availability levels are much better than those supplied by simple files. Furthermore, storing spatial and descriptive data in one single database structure minimises costs compared with the exploitation and hybrid storage required if these data are stored in separate databases. In addition, this option allows queries to be made in SQL, combining spatial information and classical information.

Geometric data becomes interoperable between various GIS tools, such as Mapinfo, Esri and Autodesk, but can also serve as a link between classical IT and Oracle Spatial mapping applications, enabling the geometric data to be used in any application.

### COMPLEX QUERIES

Oracle Spatial 11g enables integration of the native support of all types and models of geo-spatial data including vector and matrix (raster) data, as well as topological and network models to meet the needs of cutting-edge Geographic Information Systems (GIS) for applications such as territorial management, public service management, defence and internal security management.

Vector data allows storage of vectors (dot, line, surfaces). Raster data (of the type SDO\_GEORASTER) allows storage and manipulation of geo-referenced images. The topological data model preserves and manipulates data in a topological form (nodes, arches, faces). The network data model can represent networks of roads, waterways, distribution networks, etc and allows travel along them.



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In addition, this module includes 3D and web service support to manage all the geo-spatial data. This option allows solid 3D modelling and visualisation, and introduces a web service platform in order to access, incorporate, publish and deploy geo-spatial services such as routing (itinerary calculation), geocoding (recognition of addresses and their transformation into geographical points), company yearbooks, catalogues, geo-spatial features and mapping. Oracle Spatial 11g can also make geometrical transformations, spatial aggregations, dynamic segmentation, conversions of projections, definition of specific projections and Spatial "Data Mining".

Apart from dealing with solid 3D, Oracle Spatial 11g can also do LRS and thus manage 3D (2D + measure) or 4D (3D + measure).

## INTEGRATION OF GEOLOCALISATION IN COMPANY APPLICATIONS AND PROCESSES

The Spatial Option also easily integrates geolocalisation in company applications and processes and deploys geolocalisation services for companies. Thanks to the Oracle Spatial native geocoding engine, its itinerary calculation engine and its Start eLocation APIs, rapid mapping, geocoding and itinerary calculation services can easily be deployed directly from data stored in Oracle Spatial. This makes it possible to make localisation analyses on various types of data (ie data concerning customers, employees, competitors and suppliers) and to visualise this data using Oracle's or Oracle's partners' mapping tools.

## THE STORAGE FORMAT IS SPECIFIED BY THE OGC (OPEN GEOSPATIAL CONSORTIUM)

Furthermore, the type of spatial data in Oracle is compatible with open standards, so Oracle can be used as the central and interoperable reference for geo-spatial data because it can supply data to any partner application. Spatial data can therefore be shared more easily between various company services or organisations, allowing them to be valorised at reduced cost.

More technically, Oracle spatial functions are accessible via standard languages such as SQL and Java, and Oracle promises to support the new Geographic Markup Language (GML) of the OGC as well as Open Location Service interfaces. Also, Oracle uses an object-relational model to store geometries, which is in conformity with the specifications associated with the SQL92 representation of dots, lines and polygons. In addition, Oracle Spatial supports SQL/MM types and spatial operators. Lastly, geographical and localisation data are manipulated using the same semantics as that applied to CHAR, DATE or INTEGER types.



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## 5. Summary

**Table 1: Oracle Spatial 11g, Oracle MapViewer and licences**

		Licence database		
		Express Edition (XE)	Standard Edition	Enterprise Edition
Oracle Spatial 11g Module	Oracle Locator	OK	OK	OK
	Option Oracle Spatial 11g	\	\	OK (premium option)
		Licences of the Oracle application server		
		WebLogic Server Standard Edition		WebLogic Server Enterprise Edition
MapViewer		OK		OK

**Table 2: Caractéristiques d'Oracle Locator, de l'option Oracle Spatial 11g et d'Oracle MapViewer**

Oracle Locator	Storage of geometries (2D and 2.5D)
	Spatial indexing
	Coordinate system management
	Transformation of coordinate systems
	Simple queries (buffer etc)
	2D
Option Oracle Spatiale 11g : Oracle Locator +	Storage of 3D and solid geometries
	Network data model
	Topological data model
	Geocoding
	Itinerary calculation
	Web services: WFS (Web Feature Services), CSW (Catalogue Services for the Web), Location etc.
	Complex queries
	Georaster
MapViewer	LRS: 2D+measure, 3D+measure
	Mapping restitution
	WMS (Web Map Services)
	XML queries
	Javascript API, OracleMaps
	Oracle MapBuilder

## References

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Dernière visite le 21/10/2011.

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