Product Survey on Geo-databases

This is the fourth and last in the present form of in a series on 'Spatial Data Management in Geo-databases' (RDBMS) since its introduction in 2002.

Developments in Geo-Information and Communication Technology (ICT) have a serious impact on the development of geo-spatial data infrastructures. Developments in ICT such as internet, database management systems, information system modelling standard UML (Unified Modelling Language), and positioning systems, improve the quality, cost-effectiveness, performance and maintainability of geo-spatial data infrastructures in all its manifestations. Users and industry have accepted standardisation efforts made in the spatial area by the Open Geospatial Consortium and the International Standards Organisation. Many internet-GIS applications are already operational, and this may also be said of mobile GIS applications.

Geo-databases are the 'spider in the web' in these developments. (Open source) geo-databases like PostgreSQL and MySQL open up perspectives in such developments, also in less developed countries. Today the functionalities for information management are so comprehensive that their representation within a Product Survey template such as that used over recent years in GIM International is complex. For example, subjects like 'spatial indexing', 'optimising approaches', 'spatial joining algorithms' and 'topology management' may relate to very sophisticated approaches not easily condensed and described in a survey matrix box. In my first Product Survey on RDBMS in 2002 I observed that spatial-data management was traditionally supported within GIS environments. Integration with other datasets has to be organised within such environments with the aid of complementary architectures. As more and more support for spatial-data management becomes available in RDBMS, direct integration with other datasets may be organised in an increasingly flexible way. This allows for fast data access, easy product development, avoidance of duplication of spatial data etc. Five years on, a set of mature geo-databases is available on the market, and a product like PostgreSQL has, of course, a much longer history. Thanks to OGC, developments have been rapid.

This Product Survey is based on information provided by geo-database suppliers; it is not a benchmark and it is not related to any assessment. A new series of features on geo-databases in GIM International would be a better approach to further introducing the functionality, applications, references and integration in geo-spatial data infrastructures. All Geo-database suppliers are invited to contribute their ideas.

I would like to thank all providers of geo-databases for their support over the past five years; I look forward to further co-operation in the near future. And I should like to thank Prof Peter van Oosterom, University of Delft, in the Netherlands, for his support in producing this Product Survey.

Christiaan Lemmen, contributing editor, GIM International

Brand	IBM DB2 Universal Database (UDB)
DBMS Product Name/version	DB2 Spatial Extender V9 / DB2 Geodetic Data Management Feature
Date of Introduction (year/month) Current version	2006, July V9
Standardisation	
OGC compliant	Implements the OGC Simple Features for SQL Using Types and Functions
ISO standards support	Implements ISO SQL MM Part 3 - spatial
Spatial data types, -operators and indexing	
Spatial data-types (vector-oriented) 2D, 3D	OpenGIS Simple Feature Specification Types: ST_Geometry, ST_Point, ST_LineString, ST_Polygon, ST_MultiPoint, ST_MultiLineString, ST_MultiPolygon; enhanced with linear measure and Z-values
Support of curved objects 2D, 3D	❐
Spatial data-types (raster-oriented)	❐
Spatial data-operators (vector-oriented)	OpenGIS Simple Feature Specification Operators: Relationship Operators Production Functions Transformation Functions, Computation/Accessor Functions, I/O Functions, Other Functions
Spatial data-operators (raster-oriented)	❐
Spatial data index 2D, 3D	2D-grid index (Spatial Extender V9), 2D-Voronoi index (Spatial Data Management Feature)
Supported co-ordinate systems/projections	2037 (Spatial Extender V9), 319 (Spatial Data Management Feature)
Spatial data clustering support	Documented clustering/reorg approach (Spatial Extender V9)
Functionality	
Topology support (node, edge, face)	❐
Linear networks support	❐
Linear referencing	Y
Spatial join algorithms	Y
Support of spatio/temporal models (e.g. versioning)	❐
Data exchange	
Exchange formats	Shapefile, WKT, WKB
XML, GML, CityGML, X3D, KML output	AsGML() function
Other	
Optimising approaches	Integrated with DB2 UDB SQL query optimiser
64 bit platform support	Takes full advantage of available memory and runs on 64-bit versions of all supported operating systems.
Other	DB2 plug-in provided for Open Source GeoTools, GeoServer and uDig projects Spatial functionality can be used within DWE (Data Warehouse Edition) Design Studio and Intelligent Miner
Platform	
Platforms	Windows, Solaris, Linux (IA32, AMD64, zSeries), HP-UX

N/A = Not Applicable
❐ = No information received

MySQL	Oracle	PostGIS
MySQL 5.0	Oracle Database 10g Release 2 Enterprise Edition (with Oracle Spatial option); Oracle Locator, is included at no cost	PostGIS 1.2.1
MySQL 5.0.33 shipped 2007, January	2004, January	2007, January
SQL with Geometry types'. Compliant with the exception of precise spatial operations	SFS1; GML 2.0; OLS 1.1; SRS;WMS 1.1 test passed - pending submission for certification	SFSQL-TF 1.1 CERTIFIED
❒	❒	SQL/MM
2D only. Rtree keys	All spatial data types supported in SFS1 + circles, arcs, combinations of arcs and lines and rectangles; Coord Trans support; LRS functions; Projection Management; fully integrated with Raster data types. Support for 3D storing of lines/points/polygons	As specified in OGC SFSQL: Point, Linestring, Polygon, Multipoint, Multilinestring, Multipolygon, Geomatrycollection
N	❒	As specified in SQL/MM: Curvestring, Compoundcurve, Curvepolygon
N	Multi-band, Multi-sensor BIL, BIP and BSQ and Grid-based data (e.g. DEM, DTED etc.) are supported using GeoRaster data type. Generic non-spatial types such as .tif, .jpg, .gif, .bmp, .png are supported as well; integrated with vector data types	CHIP datatype to store rasters in PostgreSQL
N	Inside, overlap, intersect, .. (Egenhofer) + Within Distance, Nearest Neighbour+ area, length + mbr, centroid, etc. + union, intersect, or, xor + aggregates	OGC + ST_* + PostGIS Specific - several hundred data-operators are supported
N	[1]	Input/output only
2D	[2]	2d RTREE (with multi-version concurrency and recovery)
N	Forthcoming release will support 3D coordinate systems, a new geometry type for 3D data, a point-cloud data type and TIN data model.	All EPSG CRS systems - European Petroleum Survey Group (EPSG) Coordinate Reference Systems (CRS) (this means most systems and projections are covered)
Partially with the NDB cluster	Spatial data clustering can be implemented by end-users. However, performance optimisation features removes the need for spatial data clustering in most commercial applications. R-Tree-based and Quad-Tree-based spatial data clustering can be implemented	CLUSTER SQL Command applied on the spatial index. PostGIS/PostgrSQL can run in an 'application cluster' by using Slony to create mirrored read-only copies of the data, so that query load can be made parallel across multiple computers.
N	Full support for planar topology via the sdo_topology data type. Topology to be validated and maintained in a persistent state in conjunction with the geometry it describes.	SQL/MM Topology Model + Basic Functions
N	❒	N
N	Y, linear Referencing can support 4D	Y
Partially	❒	Spatial join using index operations, spatial/ attribute query optimisation
N	[3]	Models can be created that neatly timestamp every transaction and never delete rows and keep a persistent history table for revision control.
SHP	❒	All FME formats (all of them)
N	[4]	GML, SVG, KML
❒	Performance optimisation features like parallelism, partitioning , and global and partitioned indices	[5]
❒	Y, since 1996-7; RAC since 2001	PostgreSQL / PostGIS support 64-bit platforms, and the huge memory sizes that implies
OSGeo FDO Provider for MySQL	[6]	Kriging and other statistical functions via the PL/R statistical add-on and PostGIS modules for R. Supports CadCorp SIS, FME
Linux (many flavours), Windows, Mac OSX, Solaris, IBM AIX, HP-UX, FreeBSD, SCO OpenServer	All major Unix including Linux, HPUX, Solaris, AIX, Windows, IBM Mainframes	[7]

[1] Crop, Scale, Transform and more than 110 other functions that operate on raster cell, metadata and gridded data affecting colour map, statistics, SRS etc. are included in support of the GeoRaster data type.

[2] Self-tuning, highly optimised R-Tree indexes provide efficient support for query and retrieval. Index performance is further enhanced by using database server infrastructure such as partitioned tables to meet and exceed enterprise-class requirements. R-Tree supports 3D indexing. Quad-Tree indexes are also supported.

[3] Workspace Manager maintains versioned tables; the version will always be part of the primary key. Changes can be tracked, versions can be maintained and consolidated and conflicts between versions can be resolved in support of applications that require long transactions. The time data type supports a range of temporal analytics.

[4] Support for Oracle Spatial has been pervasive in Autodesk Mapguide, ESRI's ArcIMS, Intergraph's GeoMedia and MapInfo's MapXtreme etc. Typically a mid-tier connection via a pre-defined Java API using Thin JDBC protocol will be used. Support for GML 2.0 and much of GML 3.0. Oracle's Application Server includes both a visualiser (MapViewer) and a collection of open API's (LBS Framework) that facilitate consumption of internet services such as the OGCs Open Location Services. Transparent support for heterogeneous mobile devices. Forthcoming: Transactional Web Feature Server (WFS-T), Web Catalog Service, OpenLS.

[5] PostgreSQL has a generic optimiser, and the PostGIS tables are fully integrated into the optimiser, so complex queries will produce plans that reflect the most efficient use of the combined spatial and non spatial indexes.

[6] Geocoding (with appropriate content), Routeing and Route optimisation, Network Data Model, Spatial Analytics, Validate Geometry, Validate Topology, Projection Management/SRS, Geodetic Support (Current); Single system with integrated support for vector, raster and persistent topology as native types."In repeated surveys, IDC has found that Oracle is used in an 80%-90% share of Spatial Information Management (SIM) oriented database installations. IDC Report, 2003. Complete integration with Oracle database server (the Oracle database server ships standard with operational support for vector types, spatial indexing, basic spatial operators etc.). Highly performant, low maintenance R-tree indexes; Complete integration with mid-tier for native map visualisation and consumption of internet location-based services (e.g. geocoding, routeing, yellow pages, region modelling, privacy and presence etc.).

[7] AIX (PowerPC, RS6000), BSD/OS x86, GNU/Linux (Alpha, AMD64, ARM, Athlon XP, IA64, m68k, MIPS, MIPSEL, PA-RISC, PowerPC, Sparc, x86), HP-UX (IA64, PA-RISC), IRIX MIPS, Mac OS X (PowerPC, x86), NetBSD x86 Solaris (Sparc, x86), Tru64 UNIX Alpha, UnixWare x86, Windows (with Gygwin) x86.