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Integration of LIS and Core Enterprise Information

Location-enabled Platform Technology

Location-based information is increasingly becoming an integral component of mainstream business applications. The need effectively to manage this 'special' data with core enterprise information is becoming pressing. Key infrastructure features such as raster data, network data models and persistent topology have recently emerged, making location-enabled platform technology a reality. This technology will enable enterprises in the private and public sectors to improve efficiency and make better decisions, thereby reducing costs and enhancing performance. The author discusses developments in, and enterprise benefits of, location-enabled platform technology.

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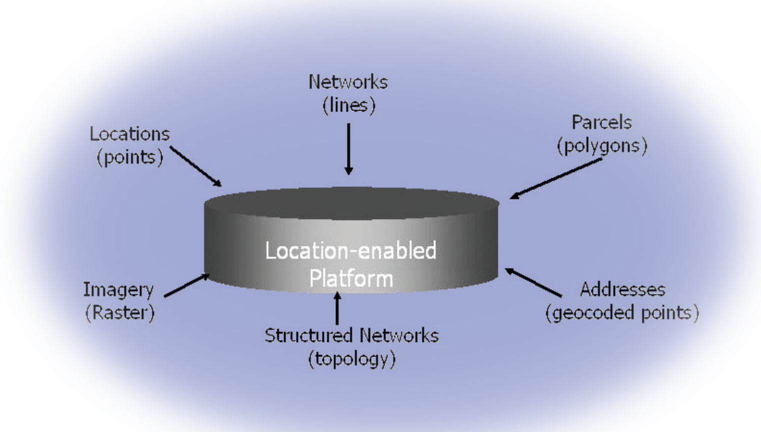

Figure 1, *The location-enabled platform can store and manage all types of location data for both enterprise GIS and core business applications*

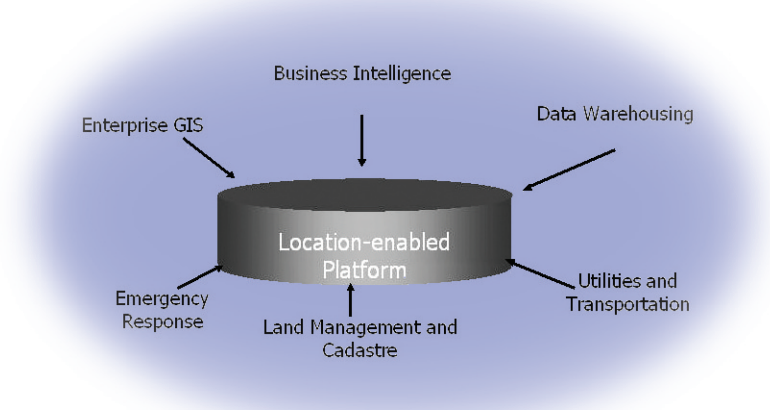

Figure 2, *The location-enabled platform integrates enterprise GIS and core business applications*

The market for highly specialised GIS continues to grow at annual rates of ten to fifteen per cent. Meanwhile, larger growth is expected in mainstream business applications including call-centres, data warehousing, customer relationship management, service delivery and e-commerce. Table 1 sketches an overview of the Spatial Information Management (SIM) market.

Location-enabled Platform

The rise of the Internet and the reality of ubiquitous connectivity made the notion of highly integrated and shared repositories a realistic concept. By sharing a common data store redundancy is eliminated and errors in consistency and versioning can be minimised. Furthermore, integration across business units within an organisation may have a positive institutional impact that drives efficiency and even innovation. Such effective management of spatial and attribute data in a single platform - with common storage, indexing, query optimisation, security and user management - reduces processing overheads. In addition, it will deliver the security, scalability and replication required in mission-critical business contexts. The immediate benefits of the location-enabled platform approach include:

- Spatial and all attribute data stored in a single server
- Seamless geographic coverage without tiling
- Better management of spatial data, SQL access
- Elimination of hybrid GIS architecture and schemata
- Simplified systems management
- Standard spatial types with avoidance of proprietary data structures

- Support from leading GIS and location technology tool vendors
- Unlimited (multipedabyte) size
- Version management for short and long transactions

Core Capabilities

A location-enabled platform allows the handling of location data just like any other data; it becomes a coherent part of an integrated infrastructure available to all applications (Figure 1). This approach also eliminates the proprietary encoding of spatial data and provides an open standard interface (SQL) for query, retrieval and analysis of spatial data. Standard features of spatial databases include:

- Spatial (R-tree) indexing
- Spatial operators determining interaction of geometric features
- Relationship operators
- Open, standard SQL access to spatial operations
- Spatial referencing system
- Whole Earth geometry model
- Spatial functions such as buffer, area and length calculations and aggregate functions
- Linear referencing system
- Coordinate transformations
- Function-based spatial indexes
- Partitioning support for spatial indexes
- Support for parallel index builds
- Support for parallel spatial queries

Improvements

Location-enabled platform technology continues to evolve as needed infrastructure components are introduced. Database vendors such as Oracle, with its new 10g offering, incorporate new spatial features that increase performance and broaden the range of applications that can be supported (Figure 2). Location-enabled platform technologies now exhibit features such as:

- Network Data Model - a data model is provided to store network (graph) structure in some spatial databases which explicitly stores and maintains connectivity of link-node networks and provides network analysis capability such as shortest path and connectivity analysis. This feature supports applications in transportation, transit, utilities and life sciences
- Navigation Routing Engine - a spatial database now supports navigation routing (driving distances, times and directions between addresses). 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
- Topology Data Model - this fea-

SIM Market	Example 1	Example 2
GIS	Query topographic data for floodplain and basic land management	Combine with population data in a single database to support disaster preparation and relief
Utilities Infrastructure	Maintain spatial database of the entire network including individual poles, lines, hydrants or distribution centres	Overlay road and housing data for 'dig safe' queries. Manage 'long transactions' through version management
Energy Exploration and Distribution	Maintain virtual maps of underground oil or gas deposits	Determine where to locate drill sites, refineries or storage facilities
Supply Chain Management	Optimise the flow of goods through the supply chain (product mix, inventory, distribution, warehousing and shipment routes)	Add a location dimension to a supply chain so that suppliers can directly review and take action on information that affects them
Customer Relationship Management (CRM)	Enable organisations to understand, anticipate, and respond to their customer needs in a cost-effective manner	Expand service delivery, shorten response time, improve efficiencies and reduce costs for the fastest ROI through incorporating spatial relationships into solutions
Data Warehousing/ Business Intelligence	Analyse all transactions being collected in ERP systems (customer purchasing, sales, asset characteristics by time and place) to derive insight and enhanced decision making	
Enterprise Asset Management	Manage, maintain and track enterprise assets using images, network data and core business data to reduce cost and improve efficiency	
Field Service	Optimise scheduling; improve service performance and track vehicles and driver performance via wireless and disconnected location-enabled services	

***Table 1,** Spatial Information Management (SIM) market with examples of applications*

ture maintains in an environment with frequent transactions and edits data integrity, essential for large land management agencies and data producers in the private sector
- Raster Data Management - geo-referenced remotely-sensed data like satellite imagery and gridded data provide infrastructure for many applications such as environmental management, defence/homeland security, energy exploration and satellite image portals
- Geocoding Engine - associating geographic references such as addresses and postal codes with location coordinates adds flexibility and convenience to customer applications
- Spatial Analytic Functions - new server-based spatial analysis capabilities such as classification, binning, association and spatial correlation enable application developers to deploy spatial data mining operations on a variety of point-based features
- Map Visualisation - visualisation helps rationalise complex relationships in an easily understandable way. This feature enables the creation of maps of query results and identification of patterns in business data and can be used as a heuristic to develop queries themselves

Benefits

The location-enabled platform benefits an entire organisation; the use of industry standards such as OpenGIS, ISO-TC211 and SQL-MM makes possible the accessing by multiple client tools of common information. Individual departments are not forced to standardise their tools and applications. Instead, what is standardised is the underlying data model and each department is free to use the tool that best suits their needs. Industry-standard schemata also enable the use of access mapping in the Planning department, network data in the Engineering department, and land management data in the assessor's office. In this way an organisation leverages its investment in location data. Increasing operational efficiency also provides savings by eliminating redundancy and reducing training and support/SI costs. In addition, the coherent information base results in more informed, and thus better, decision-making.

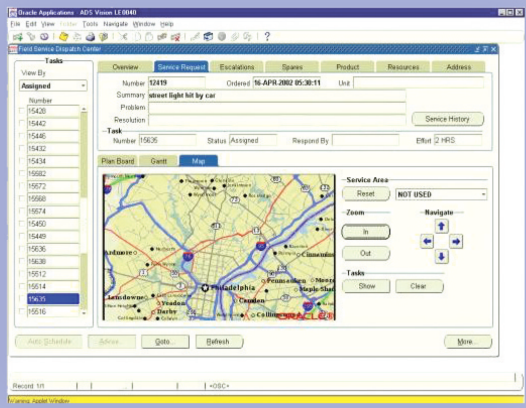

Figure 3, Core business applications such as field service, asset management and supply chain are enabled by location-enabled platform infrastructure technology

Applications

The location-enabled platform makes possible corporate e-Business applications like Customer Relationship Management (CRM), Enterprise Resource Planning (ERP) and Business Intelligence (BI), see Figure 3. Utility providers, for example, can compete on the basis of how effectively they can integrate their CRM and field service operations with those of customers and suppliers to create a positive business experience. Integrating enterprise information with location-enhanced customer information gives utilities comprehensive business intelligence, leading to an exponential growth in value: they may now use real customer information to determine service expansion, improve service delivery and determine load demands.

Interoperability

Interoperability standards enable the integration of location-enabled platforms with GIS tools and mapping applications. For instance, Oracle Locator and Spatial are directly integrated with the leading GIS mapping and location services technology vendors. This combination of platform technology and partners' tools enables developers to rapidly deploy scalable, secure enterprise GIS and location service solutions. In this ongoing process vendors work to influence and adopt the latest open standards.

Acknowledgements

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Biography of the Author

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Jim Farley leads Oracle Spatial Product initiatives in raster technology, hosted location-based services and in the integration of location technologies across Oracle eBusiness Suite Applications. Prior to joining Oracle he served as Technical Director of the Center for Advanced Spatial Technologies (CAST) and as Chief Technology Officer and Professor in the Fulbright College of Arts and Sciences at the University of Arkansas. Mr Farley received a Smithsonian Laureate for his work in distributed spatial data warehousing for government in 1999 and he is a founder of the OpenGIS Consortium.

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