A NEW INSIGHT TO GIS USING MAPVIEWER AND SPATIAL DATA

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ABSTRACT: Geographic Information System (GIS) may be defined as a system used to store, retrieve, and render the spatial data related to earth. So far the geographic data has traditionally been managed in proprietary-formatted files and special GIS are used to display it, and, now object-relational databases formats are used for handling the emergent data management. There is a special need to resolve some critical issues in order to effectively meet the requirements of these applications. Two such issues are: representation of spatial data and the content-based search of multimedia and spatial data. These issues can be well addressed by Oracle Spatial which provides an object data type (SDO_GEOMETRY), indexing capability, and functions/operators on SDO_GEOMETRY. It enables spatial data to be stored, accessed, and analyzed quickly and efficiently. The use of Oracle Spatial thus can help the application developers to store all location (geographically referenced) information within an industry standard database server without having to resort to custom-built external indexes and functions to get the functionality they need.

The use of MapViewer will provide powerful geospatial data visualization and reporting services. It is used by web application developers as a means to integrate and visualize business data with maps. Though a lot of geo-data have been using different GIS systems in the last decade but still there lies a huge opportunity in this field due to the advent of advanced technologies in Internet. The different data format used to explore the huge geo-data repositories makes it difficult for accessing.

This research paper thus proposes for a framework to enable the use of the geo-data repositories laid-down in different formats. The research proposes a layered architecture, consisting of web-enabled end-user interface, web services, data exchanging components and the underlying geo-database so as to provide an easy access to a common man who is not technically sound in terms of geo-data jargon.

KEYWORDS: WWW, Spatial Data Access, Geo-data, MapViewer, GIS

IMPORTANCE OF SPATIAL DATA

We are living in the information society, so information is the key transforming resource in the new society that's not bounded by any geographic boundaries. The spatial data plays a major role while implementing any type of Information Systems for any technology advanced nation. The location data is utilized in every discipline, everywhere. Informative and interesting maps are providing better decision making tools and analysis techniques, and making a big difference in our world. There is a growing realization that 70%-85% of data in all databases has a spatial component, which can explore in a variety of ways for more effective analysis and display. Geography is helping people make better decisions in many disciplines. Spatial data can be gathered and organized to support the generation of information products that are integrated in the business strategy of any organization. A Spatial enabled information system is not an end in itself. It is used to create useful information products that help organizations run better. It has saved hundreds of millions of dollars through increased productivity and efficiency. And that's just the beginning.

Most computer technology is designed to increase a decision-maker's access to relevant data. GIS goes beyond mining data to give you the tools to interpret that data, allowing you to see relationships, patterns, or trends intuitively that are not possible to see with traditional charts, graphs, and spreadsheets. More than that, a GIS lets you model scenarios to test various hypotheses and see the outcomes visually and to find the outcome that meets the needs of all the stakeholders. For example, a retail manager looking to build a new store can analyze consumer demographics and the locations of competitors in relation to potential locations in a spreadsheet view. GIS lets that manager visualize potential locations on a map along with drive-time analysis, environmental concerns. Taking a

longer psychological, social, and historical view of Every Citizen, we realized maps of all kinds powerfully condition our thinking about the world beyond our immediate view space. GIS, which enable interactive viewing and intersection of multiple spatially coincident maps representing diverse cultural and natural themes, promote holistic, cross-disciplinary thinking.

FEASIBLE SPATIAL DATA ENABLED SOLUTION FOR BUSINESS

Business world looks for intelligent processes to derive information from available data. In the Information Age, corporations have at their disposal massive amounts of data, collected in transactional systems. These systems are essential for businesses to keep track of their affairs. Having data is not the same as having information. Data becomes information when you can use it to answer business questions, so that you can understand your business better. Information System allows you to answer those questions effectively, so that the decision makers at all levels can respond quickly to changes in the business and its environment. This begins with the day-to-day information that you need to run your business. Current database technologies are not designed to handle extremely large, multidimensional data sets for long term archival. This is mainly due to the instability of the Relational Database Management System (RDBMS) applications themselves, which are constantly evolving and changing internal structures with each new version. This condition does not ensure backward compatibility of database applications which are necessary for long term archival. Clearly this has a direct impact on the stability and usability of very large data sets. But the Oracle Database with numerous features in the area of performance, scalability, reliability and security fills the gaps left behind RDBMS. Though the awareness and utility of Oracle Database over RDBMS is still not widely spread, but with the advent of technology, it is indeed possible to use location not only as an address or a point on a map, but as a way to reveal trends based on market share, population concentration, or complex location-based interactions. The Fig. 1 describes a process for meeting that goal across all lines of business using the same enterprise reporting tools that are commonly used for relational data.

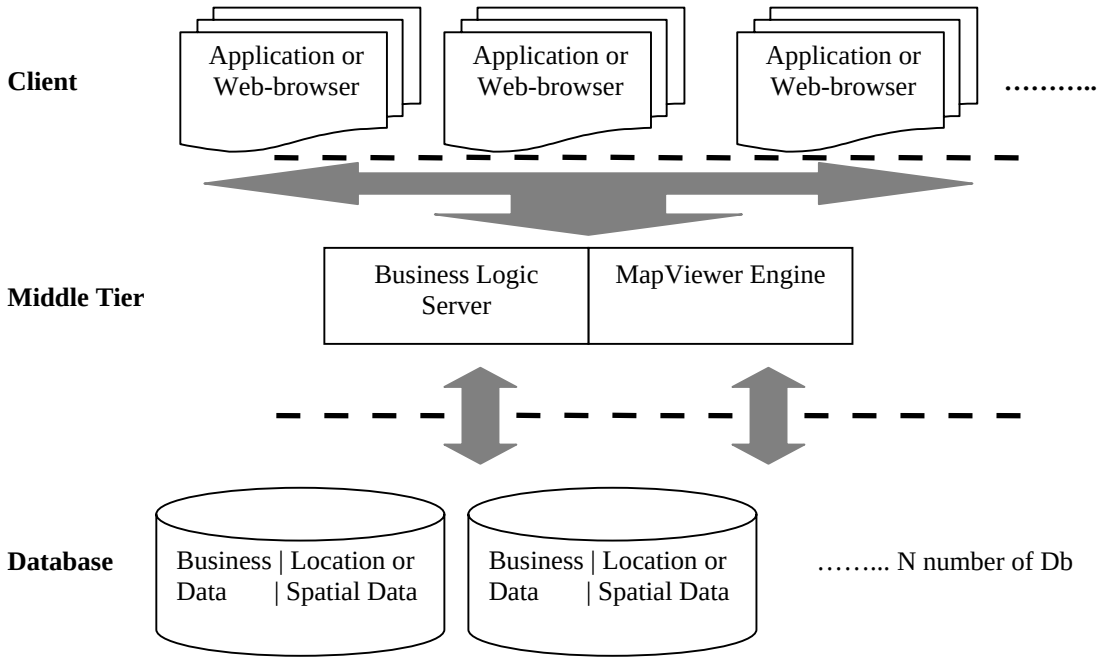


Fig. 1

There is a need to enable a development environment that “bridges the gap” between traditional location analytic tools and business systems. To establish a proper context, one must understand that spatial capabilities should be integral part of Information management strategy and products rather than a specialized application. ***Spatially Enabled Systems should quickly migrate from specialized Geographic Information Applications to broad relevance within IT ecosystems.*** This migration required a spatially enabled IT infrastructure. Geospatial technologies are increasingly shaped by a broad IT integration imperative: the driving need to coordinate information

to support business processes. This means that geospatial capabilities will have to be tightly integrated into applications as those capabilities are needed and managed as part of secure, adaptable information systems.

Spatially enabled Oracle database is an integrated set of functions and procedures that enables spatial data to be stored, accessed, and analyzed quickly and efficiently in an Oracle database. Spatial data represents the essential location characteristics of real or conceptual objects as those objects relate to the real or conceptual space in which they exist. In the same reference Internet also redefines the ways in which location information is collected, managed, queried and disseminated. Location-based services are now deployed on large, professionally managed servers and accessed via Internet browsers and mobile interfaces. Smaller numbers of large servers are being used to consolidate databases, resulting in lower costs, improved reliability, heightened security, and dramatic improvement in quality of services. This can be done with Oracle 10g for Grid computing that helps in removing the fixed connections between applications, servers, databases, machines, storage, components of the grid by treating everything in the grid as a virtualized service. This will help business to increase their hardware utilization and resource sharing, enabling them to scale out incrementally with low-cost components and reducing management and administration requirements.

The only way to make location applications scale to meet the requirements of Internet and wireless deployments is to embed spatial capability natively into the database, which can then be virtually accessed by any client device. This enables "N" number of clients to access the common and huge amount of location data. This also reduces the redundancy of such data, and that can be done with Oracle Spatial Database. Extension of commercial database technology to accommodate the location based or spatial data which upgrades GIS is not new. There have been efforts to integrate robust data management system with the analytics and visualization tools which are commonly used in GIS have been under one form or the other since the existence of such systems for spatial analysis. ***There have been many attempts in academia and in both the public and the private sectors to accomplish this integration. However, only a limited number of these initiatives were sustained and even fewer managed to grow and mature over time.***

Oracle Spatial is designed to make spatial data management easier and more natural to users of location-enabled applications and geographic information system applications. Once spatial data is stored in an Oracle database, it can be easily manipulated, retrieved, and related to all other data stored in the database. A common example of spatial data can be seen in a road map. A road map is a two-dimensional object that contains points, lines, and polygons that can represent cities, roads, and political boundaries such as states or provinces. A road map is a visualization of geographic information. The location of cities, roads, and political boundaries that exist on the surface of the Earth are projected onto a two-dimensional display or piece of paper, preserving the relative positions and relative distances of the rendered objects. Oracle provides the industry's leading spatial database management platform. Every Oracle database includes built-in location features that enable any business application to directly incorporate location information and realize competitive advantages. Oracle Spatial 10g includes support for all geospatial data types and models, including vector and raster data, and topology and network models, meeting the needs of advanced GIS systems such as land management, utilities, and defense/homeland security. One key feature of Oracle's open, native spatial support has in eliminating the cost of separate proprietary systems and is mainly supported by the leading Geographical Information Systems vendors. To produce intelligent report, we need historical data or data from a number of different sources. The solution for this kind of requirement is often built upon a data warehouse. We can use Oracle that delivers industry-leading security, performance, scalability, and manageability for mission critical spatial assets stored in its native type. This helps in maintaining the regular business data and location data on the data warehouse environment. A data warehouse is a relational database that is designed for query and analysis rather than for transaction processing. Data warehouses separate analysis workload from transaction workload and enable an organization to consolidate data from several sources. Data warehouses often integrate data from a number of transactional systems, making it possible to compare and to analyze data from a broad base of source data. After data is loaded into a data warehouse, it is not changed except to correct errors. This integration of nonvolatile data allows the data warehouse to be a single source of truth for answering business questions. Unlike transactional systems, data warehouses store historical data. This historical data is crucial to business intelligence, which requires analysis of past performance.

So far business collects and analyses data (Primary and secondary) which revolves around business subjects such as customers, products, time and other trends. This data so collected is used for answering various questions related with the existence and growth of the business. This was one of the primary activities of business intelligence. As the business environment is becoming more dynamic the past methods of collection and analysis of data are not sufficient. We thus look for the need of a spatial database which enables the business communities to take advantage of the available data related to the different geographical locations and layouts. To retrieve and process the data we can use online analytical processing (OLAP) and data mining capabilities, client analysis tools, and other applications.

INTEGRATING ENTERPRISE GIS WITH CORE BUSINESS APPLICATIONS

To create a robust infrastructure technology with the capacity to support location data analysis requirements Oracle has sustained a consistent, focused development effort. It also supports the requirements of those core business applications that can be optimized, enhanced, or extended through incorporating spatial data, visualization, and the concept of basic spatial relationships. The core functionality (available in every database) is referred to as Oracle Locator. To support enterprise GIS applications Oracle Spatial adds high end infrastructure features to the core functionality of Oracle Locator. The various geospatial sections of the society including the commercial sector, various standards communities, and academia complements the Oracle's Locator features by input, guidance and constant review comprehensively. This provides a boost in the efforts of the decade long Oracle. The Oracle location enabled platform currently supports an installed base of enterprise applications across government, communications, utilities, transportation, defense, a broad range of land management domains, and many other sectors. The data that indicates the Earth location (such as longitude and latitude) of these rendered objects is the spatial data. When the map is rendered, this spatial data is used to project the locations of the objects on a two-dimensional piece of paper. A GIS is often used to store, retrieve, and render this Earth-relative spatial data. Types of spatial data (other than GIS data) that can be stored using Spatial include data from computer-aided design (CAD) and computer-aided manufacturing (CAM) systems. Instead of operating on objects on a geographic scale, CAD/CAM systems work on a smaller scale, such as for an automobile engine or printed circuit boards. The differences among these systems are in the size and precision of the data, not the data's complexity. The systems might all involve the same number of data points.

Integrating location-based infrastructure into core database technology makes it possible for both the business and the GIS enterprise to use their baseline information repositories in many productive workflows as explained in fig. 1. Common database applications can store, retrieve, update, or query some collection of features that have both non-spatial and spatial attributes. Examples of non-spatial attributes are name, soil_type, landuse_classification, and part_number. The spatial attribute is a coordinate geometry, or vector-based representation of the shape of the feature. So far spatial or location-based data are increasingly viewed as integral elements of many core business applications including some advanced business intelligence and decision support applications such as supply chain logistics, enterprise asset management, material requirement planning and master production schedule. The basic functions of procurement and distributions of goods get complimented by the location database. As that location-based information become integral component of mainstream business applications, the need to effectively manage these "special" data with core enterprise information becomes more pressing. The need for core database features like security, replication and application clustering, etc., becomes greater because of this closer coupling with mainstream business requirements. It is this process of mainstreaming location data and location applications that has driven the development of many of the location features in Oracle 10g. The Oracle database platform provides the location infrastructure to support both enterprise GIS and mainstream business application requirements as they exist today and as they are likely to evolve over time.

The GIS sector is relatively mature with a knowledgeable and dedicated user community. This sector includes a tight-knit group of talented and passionate GIS technologists, a dynamic vendor community, a variety of user groups, meaningful standards activities, and well-established industry magazines and events. It will continue to grow and serve its community and geocentric workflows into the foreseeable future. Geospatial information has value and is sometimes essential. Examples include risk assessment and mitigation, transportation, logistics, defense/homeland security, sales force automation, and CRM. **Geospatial vendors should come out from their own areas for growth by offering new integration capabilities for enterprise systems.** Success for these vendors will depend on the ability to deliver simple, seamless, and inexpensive geospatial capabilities to support business processes within established IT infrastructures. As Geospatially enable technology migrates deeper into enterprise systems, spatial capabilities will have to be integrated into every aspect of the full technology stack. Formerly separate technologies such as database and data access are merging into comprehensive integration platforms. As these integration platforms evolve, boundaries between technologies blur. Over the next few years, formerly separate geospatial technologies will be integrated into the whole enterprise stack. Geography matters in every business and every discipline. Wherever you turn geography helps people do a better job and make a difference. GIS is helping thousands of organizations around the world.

How Geospatial enabled Information System fits into an organization depends on the nature of the business and the reasons for its success. It is virtually impossible for Geospatial enabled Information System to be effective if it is developed independently of the objectives, values and goals of the business they support. The system should be integrated with other systems to help them, while taking decisions. Some decisions are a matter of routine when to take a certain action that is part of a fundamental operating procedure. Other decisions may call for determining what possible actions could be considered in particular situation. If the user is the prime concern, systems will most likely orient many applications to enhance user service. If cost control is the chief measure of an organization's success, the applications are more likely to be directed towards identifying and preserving cost advantages. If new products are the key to success, then systems should help identify or create them. Generally we might be surprised at how often

situations arise that were taken into account during the design of a system and yet not effectively implemented. When this happens, and the information system can't accommodate the event, both the analyst and the system look bad, in a confrontation with a disappointed user. Thus Information System is a tool to support the (business) system. Tools are only as good as those who use them. However, the proper use of tools can identify conditions and actions that might otherwise fall between the cracks. Using these tools doesn't mean that no surprises will occur. But their incidence will most likely be much lower. Spatial enabled Information System can contribute the idea that lead to successful Information system. Geographical Data is helping people make better decisions in many disciplines. It can be gathered and organized to support the generation of information inputs that are integrated in the business strategy of any organization. A geographic information system is not an end in itself. It is used to create useful information inputs that help organizations run better. It has saved hundreds of millions of dollars through increased productivity and efficiency. And it is just a beginning. GIS is helping thousands of organizations around the world. It is used on the Internet to organize its government for constituents. Simply touch a parcel on an online map, and the information for that location is available to you. *It can be accomplished by a perfect marriage between the modern vision of Geographic data repository System and Information System.*

REPESENTING SPATIAL DATA WITH SDO_GEOMETRY

We observed that integration of spatial information with Business Applications can add value to a range of different applications and produce intelligent reports. Oracle databases maintain core business data and location data on a command database as describe in fig. 2. We already discussed the benefits of storing location information together with Business data in the database. Oracle enables storage of spatial data in the database and facilitate us to generates different types of analyze with the help of MapViewer. Oracle Spatial uses a SQL data type, *SDO_GEOMETRY*, to store spatial data inside an Oracle database as alike other data. Users may define tables containing columns of type *SDO_GEOMETRY* to store the locations of customers, stores, restaurants, and so on, or the locations and spatial extents of geographic entities such as roads, interstates, parks, and land parcels. Users can add *SDO_GEOMETRY* columns to their existing application tables. Users can populate the tables with *SDO_GEOMETRY* data using standard Oracle utilities such as SQL*Loader, Import, and Export. Alternatively, users can convert implicit spatial information, such as street addresses, into *SDO_GEOMETRY* columns using the geocoder component of Oracle Spatial. Users can query and manipulate the *SDO_GEOMETRY* data using the query and analysis component, comprising the Index and Geometry Engines. Oracle Spatial component comprises several components that cater to sophisticated spatial applications, such as GIS and bioinformatics. This includes, for example, the GeoRaster component that allows storage of spatial objects using images (groups of pixels) rather than points, lines, and vertices. The Application Server components of Oracle's spatial technology include the means to visualize spatial data via the MapViewer tool. MapViewer renders the spatial data that is stored in *SDO_GEOMETRY* columns of Oracle tables as displayable maps.

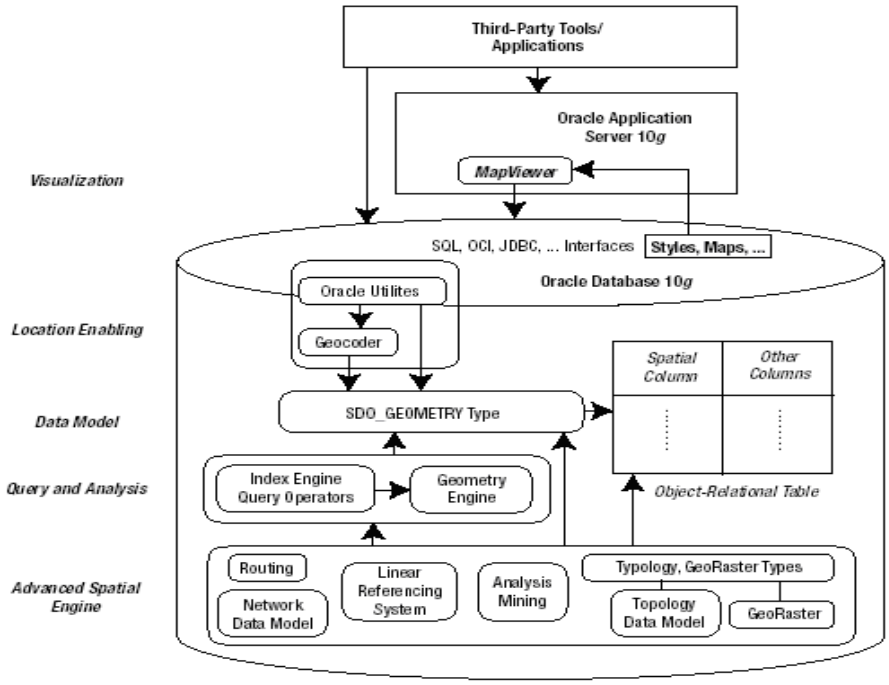


Fig. 2

The *SDO_GEOMETRY* data type captures the location and shape information of data rows in a table. This data type is internally represented as an Oracle object data type. It can model different shapes such as points, lines, polygons, and appropriate combinations of each of these. In short, it can model spatial data occurring in most spatial applications. It is sufficient to understand that we can create tables with *SDO_GEOMETRY* columns to store the locations of objects. In some applications, spatial information is not explicitly available as coordinates. Instead, the address data of objects is usually the only spatial information available. We can convert such address data into an *SDO_GEOMETRY* object using the geocoder component available with the spatial option. The geocoder takes a postal address, consults an internal countrywide database of addresses and locations, and computes the longitude, latitude coordinates for the specified address. This process is referred to as geocoding in spatial terminology.

Let us examine how to include the location data with the existing database tables. That proves the location data can be easily store as other data types in the Oracle database.

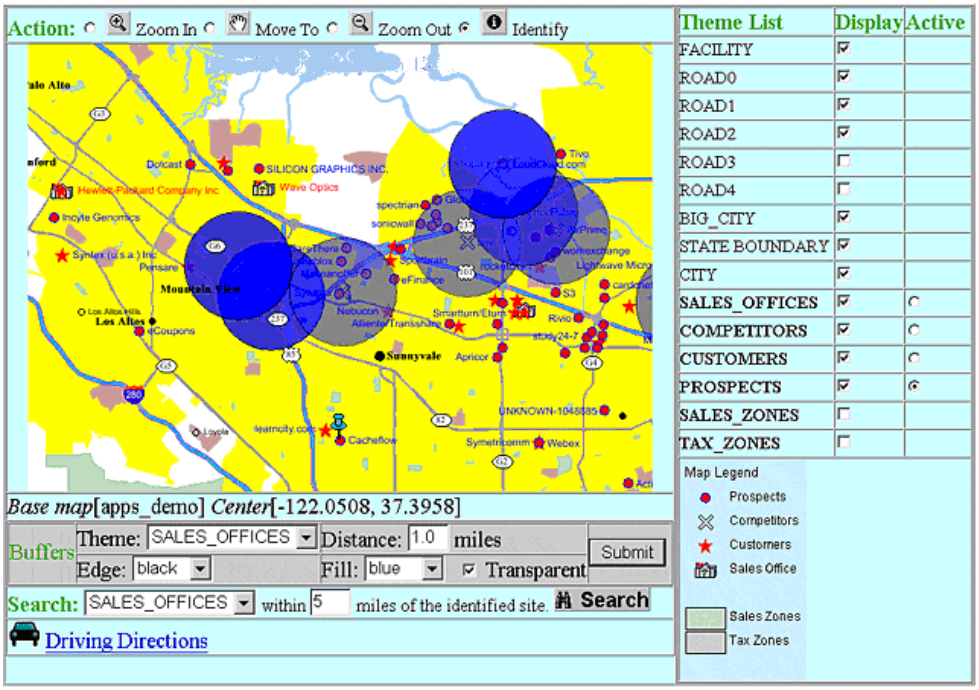
```
SQL>CREATE TABLE   India_Business
(
id              NUMBER,
name            varchar2(50),
.
.
.                                                   -- Business Data
.
.
location                SDO_GEOMETRY                -- Column to store locations
);
```

The *SDO_GEOMETRY* data type is just like any other object type in the database. Users can view the data, and examine and modify the structure.

Presently different GIS vendors maintained their own database in their own proprietary binary formats for representation of spatial information. For further use and analysis of such data these methods of collection and storage leads to various complex problems. It not only acts as hindrance for developing a common platform for all geospatial data users but also creates problems in sharing their data. These vendors usually provide tools for loading the data or converting the data into standard Oracle formats. This generates a need for the geospatial communities to develop a common platform for the use and sharing the valuable & expensive geospatial data. It will also reduce the repetition and redundancy of the available geospatial data.

CLIENT INTERFACE FOR SPATIAL DATA: MAPVIEWER

Oracle technology includes the MapViewer (Fig. 3) component to facilitate generation of maps from spatial data. Each map is associated with a set of themes. Each theme denotes spatial data from a specific table and is associated with a rendering style. Oracle Spatial provides appropriate dictionary views, *USER_SDO_MAPS*, *USER_SDO_THEMES*, and *USER_SDO_STYLES*, to define new maps, to associate them with themes, and to specify rendering styles for the themes inside the database. In addition, MapViewer renders the map for a specified map name. Basically, a servlet consults the database views and retrieves the themes and associated styling rules for a specified map name. Using this information, the MapViewer servlet generates an image of the constructed map. Simple GIS applications may just work with geographic data such as state, city, or property boundaries and index-based query using associated spatial operators. Typically, though, most GIS applications may need the Geometry Engine functionality. Business applications uses the spatial data is obtained from third-party vendors. The index-based operators supported in Locator can perform a great deal of analysis in business applications.



Identified PROSPECTS:

NAME	STREET	CITY	STATE	ZIPCODE	SALES_ZONE	TAX_ZONE
Cacheflow	1309 South Mary Avenue	Sunnyvale	California	94086	EAST BAY SALES	TAX ZONE B

SALES_OFFICES within 5 miles of 'Cacheflow':

NAME	STREET	CITY	STATE	ZIPCODE
McAffee.com	535 Oakmead Parkway	Sunnyvale	California	94086
Wave Optics	1300 Spacepark Way	Mountain View	California	94043

Fig. 3

Oracle database has developed the deepest spatial capabilities among the IT infrastructure players. The integration of spatial capabilities in Oracle Database has simplified the use of spatial data in business applications and removes much of the cost of using spatial data. The MapViewer (Fig. 3) is a tool to generate business intelligence reports with location explanations. Since Oracle's spatial features are accessible through standard languages such as SQL and Java, System developers can integrate spatial features directly into business solutions and location-based applications at relatively low costs and with minimal training. Because of Oracle's deep expertise in enterprise integration, the company's spatial capabilities are having a profound, positive effect on the applications with Spatial Enabled Information System.

CONCLUTION

This paper explores the possibilities of using the various geospatial data present in different formats by integrating the enterprise GIS with Core Business Applications. The spatial database bridges the information gap between the traditional database management system and the present requirements. The modern entrepreneur needs new dynamic technological tools to analyze the core business applications. Location database is one of them which enables him to use the geospatial database as per his needs. Thus, Spatially Enabled Systems should quickly migrate from specialized Geographic Information Applications to broad relevance within IT ecosystems.

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