The Geospatial Managed Environment

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Keywords: Cadastre;Digital cadastre;e-Governance;Geoinformation/GI;GSDI; Integration; InterOperability; Object Modeling; 3D; Information Management

SUMMARY

Bentley has been involved in the geospatial world since the early days, especially in the data creation stage. Thousands of organizations across the globe use Bentley products to create, manage and publish CAD en GIS data. For the last couple of years, Bentley Geospatial has been working on evolving its products and solution portfolio from workstation oriented products to an enterprise-wide architecture called the Geospatial Managed Environment. The Geospatial Managed Environment is Bentley's response to an ever growing demand for data accuracy and quality. It is a multi-tier architecture combining flexibility on the Desktop – using XML Feature Modeling– with a server-driven controlled environment connected to enterprise data stores like Oracle Spatial databases. Adding Oracle connectivity was crucial milestone for Bentley in designing the managed environment architecture.

For many, Oracle Spatial is the de facto standard for enterprise geospatial data stores. The Geospatial Managed Environment now offers a multi-user, scalable gateway to Oracle with true semantic interoperability. This way, Bentley positions itself as the natural partner for data accuracy and quality within Oracle Spatial data stores. By avoiding the pitfall of adding its own idiosyncratic ways of dealing with data, the solution instead concentrates on faithfully reproducing what is in the data store. Delivering true Oracle Bentley interoperability is the result of years of cumulative investment. As one of the first to identify the potential of the Oracle platform, Bentley is breaking new grounds by evolving from a two-tier to a multi-tier architecture. It believes this to be a necessary step to tackle current and future demands in the Geospatial world. Today, the use of maps or map data is ubiquitous; the use of navigation systems in cars is a good example.

The introduction of a phenomenon like Google Earth is another high profile development that caught the attention of many. As a result the demand for up-to-date, high-quality geospatial data has never been bigger. This forces the owners of data to further rationalize the data maintenance cycle, to invest in an environment that is capable of increasing productivity. With the Geospatial Managed Environment Bentley is taking the data maintenance cycle to the level where it belongs: the enterprise. By offering true ArcGIS, Oracle and SAP interoperability, Bentley acknowledges the need for Geospatial data both inside and outside the traditional GIS arena. With its encompassing software architecture it delivers the tools to make it happen.

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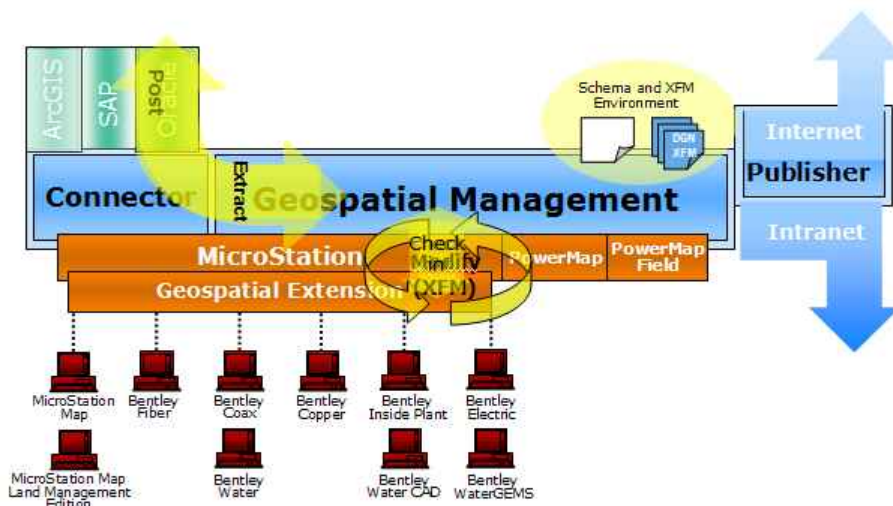
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1. INTRODUCTION

The Oracle connectivity is a crucial milestone for Bentley in designing the managed environment architecture. For many, Oracle Spatial is the de facto standard for enterprise geospatial data stores. The Geospatial Managed Environment now offers a multi-user, scalable gateway to Oracle with true semantic interoperability. This way, Bentley positions itself as the natural partner for data accuracy and quality within Oracle Spatial data stores. By avoiding the pitfall of adding its own idiosyncratic ways of dealing with data, the solution instead concentrates on faithfully reproducing what is in the data store. In short: it plays by Oracle's rules. Delivering true Oracle Bentley interoperability is the result of years of cumulative investment. As one of the first to identify the potential of the Oracle platform, Bentley is again breaking grounds by evolving from a two-tier to a multi-tier architecture. It believes this to be a necessary step to tackle current and future demands in the Geospatial world.

2. THE GEOSPATIAL MANAGED ENVIRONMENT

The Geospatial Managed Environment is one, comprehensive architecture that integrates the Bentley Geospatial product portfolio with enterprise data stores. Its design reflects one very important goal: to addresses the whole life cycle of geospatial data management, including integration of the storage of geospatial data in enterprise data stores.

The Bentley Geospatial Managed Environment

The Geospatial Managed Environment Contains a number of important principles and functionalities. Top down, these are:

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1. An Enterprise Data store – while still supporting the storage and maintenance of files, the Geospatial Managed environment gravitates towards storing all geospatial and associated attribute data is in an open system, that is easier accessible outside the engineering realm. A data store could be the Enterprise's Asset Management System or supporting Operational and Financial core processes. Prime example: Oracle Spatial databases. Other example: SAP or CRM systems.

2. Geospatial Server – the nerve center of the Geospatial Managed environment, providing a large number of functions to allow for what Bentley calls "collaborative engineering". The Geospatial in itself is built on database technology, such as Oracle. The roles and capabilities of Geospatial are, in general:

A. Long and short term transactions to the Enterprise Data store – the Geospatial Server uses Connectors to these data stores; for specific applications, also transaction messaging is used.

B. Managing of outstanding transactions by metadata – transactions are typically being processed by MicroStation-based and other environments; the Geospatial Server drives this process and keeps track of the changes in content and its metadata.

C. Managing of stand-alone Geospatial content – not all data will be stored in the enterprise data store, this is typically limited to an organization's core assets. For many purposes data will be stored in files, e.g. for departmental solutions data in files can be managed by the Geospatial Server "as is", without the requirement to migrate them to the enterprise level.

D. Managing of XFM Schema's – in the Geospatial Managed Environment the XML-based Feature Modeling environment contains the semantic model of the data it refers to. The Geospatial Server hosts these schemas and links them to either a specific use or a specific user. They faithfully reproduce the data model in the Enterprise Data stores or the data model used in the geospatial files used on e.g. a departmental level.

E. Providing Geospatial search tools on stored content – all data, geospatial and administrative, in databases or files controlled by the Geospatial Server can be viewed and searched with a geospatial interface, called the Geospatial Extension. Not only does this provide an intuitive interface on data, the powerful search option allows for map based searches for any project related content. You can "spatially Google" the data stored in the Geospatial repository.

F. Managing all project-related non-geospatial content – the Geospatial Server does not restrict itself to geospatial content. Besides maps in databases or files, all relevant project data – documents, contracts – can be stored. In other words: the Geospatial Server is capable of serving as a comprehensive Document management System and stores Excel, Word or the like.

G. Component based indexing – The Geospatial Server goes one step further than controlling the storage of files and data in Enterprise Data stores, it is also capable of indexing individual entities – components – within files or data stores. Functionality like searches, workflows are available on the component level as well.

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H. Integration with the Oracle Application Server – The Geospatial Server allows scalability at the Oracle Database level for instance towards the Oracle Database Web Services and the Oracle Business Intelligence Discoverer for Data Mining purposes.

I. Web and desktop interfaces – The Geospatial Server can be interfaced using either a desktop client or a web client. In terms of web development, Bentley is rapidly integrating The Geospatial components with Microsoft's Sharepoint.

The Geospatial environment

3. MicroStation GeoGraphics with XFM – a rich and accurate editing environment, including the possibility to define and work with geographic objects instead of atomic geometries. As a base platform, MicroStation already offers one of the richest editing toolsets in the industry. A constantly evolving product over many years, it fully responds to the industry's demands for higher accuracy. In addition to accuracy, the demand to get more "GIS" in maintenance needs to be fulfilled. For, this the concept of XML-based Feature Modeling was introduced.

XML-based   Feature   Modeling   (XFM)
The MicroStation GeoGraphics XFM (XML-based Feature Modeling) engine provides an extensible metadata driven framework to define feature properties, symbology, annotation rules and behaviors. An XFM feature may contain geometry, properties and sub-features. All feature components have linkages that define their relationship to each other.

For example, a power pole might be a feature that a utility company wants to maintain. The properties of the power pole may be type, material, pole number, id, and date installed. The figure below shows the graphic representation of the feature on the left and the XML property data on the right.

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```
 ○  #3456       <Pole>
    (1997)          <pole_num>P111</pole_num>
    P111            <ipid>3456</ipid>
    10-6            <material>10-6</material>
                    <installed>1997</installed>
                </Pole>
```

Graphic   representation   and   property   data   of   an   XFM   geographic   object

In this case, the pole is the primary (or: root) feature and that has been named Pole and the annotation is defined as a sub-feature. Three elements would be added to the Geospatial Managed Environment to define this pole feature – the pole graphical object, the annotation text, and the XML fragment element. Within the XFM paradigm, these individual objects are treated as one.

XFM was designed to bring productivity on the client for maintaining Geospatial to a new level. It offers a number of advantages. Feature geometries and attributes are contained as one, either within a single document (design file) or inside an enterprise database. Data is extracted and posted between those two sources. Features can be copied, moved, deleted; user operations   can   be   undone   and/or   redone   without   fear   of   corrupting   links.

The XFM engine is driven by XML metadata – which generated and maintained in a separate environment (the Bentley GeoSpatial Administrator). This metadata framework is used to drive that display and behavior of the geographic on the client, including property based symbology – for dynamic thematic display – property based symbology – as shown in the pole example above, the ability to define features for different plot scales, provide sophisticated placement and modification methods for manipulating geographic objects, etc. The whole XFM concept designed to provide the flexibility and depth to model/maintain Geospatial feature instances found in enterprise data stores.
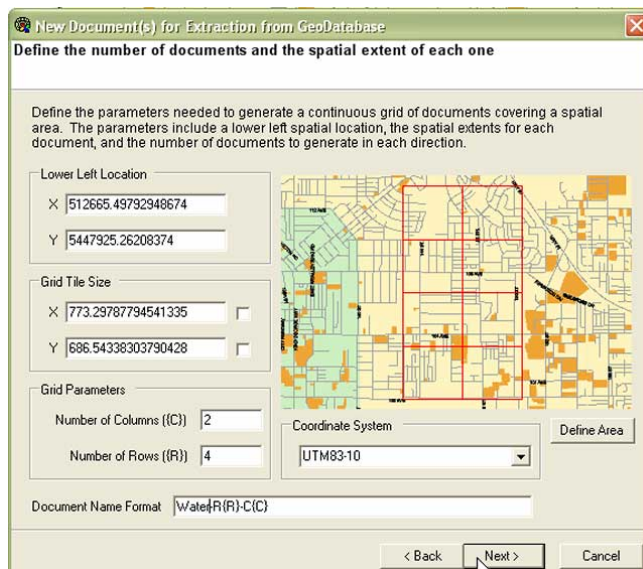
THE CONNECTOR STRATEGY

Combining the Geospatial Server and a Bentley client will ensure interdisciplinary operability. For interoperability on an enterprise scale connectivity with large data stores is essential. Especially when responding to a strong trend within the geospatial industry to migrate data to centralized spatial database.

With its connector strategy Bentley provides a gateway between the geospatial (or even: multidisciplinary engineering) world and the enterprise. Bentley has gained a lot of experience when it comes to interfacing with other systems, both on a product and a services level. For the connectors, its decision was to bring interoperability to the only appropriate level. Based on the important experience of previous development efforts, three design principles where defined:
−   True semantic interoperability – by trying to understand how the other platform works and adjust accordingly. Don't superimpose your own idiosyncratic ways of dealing with

data on the data store you want to connect to. XFM gives Bentley Geospatial clients the flexibility to adapt and adjust.

- Multi-user access – being aware that connecting to an enterprise data store means more access complexity. So develop a solution that is allows for multiple (long) transactions to be handled at the same time. Using an enterprise data store requires a sophisticated interface for locking data, replacing the simple file-locking mechanism used when data is stored in files.
- Scalability – understanding that using an enterprise data store will broaden the scope and scale of the use of geospatial data. Different departments might start to work on the same data store; people in more physically separated locations will want to access it. A system will need to accommodate this.
- Defining fundamental design principles for Bentley's connectors was not a trivial exercise; they were used as a guideline to avoid one of the biggest pitfalls around: the creation of a 'just-another-data-format' solution, i.e. the development of an expensive storage option to the DGN file. With its connector strategy, Bentley avoids this pitfall and offers a true gateway to the industry's leading solutions for enterprise data storage.

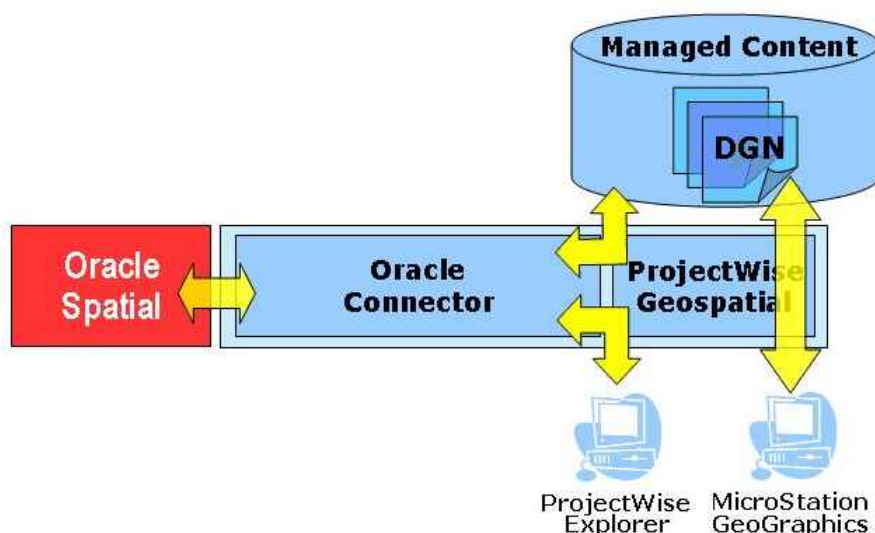Extracting of data from a Geodatabase

Oracle

For a number of years, Oracle has been positioning itself as the enterprise data store for geospatial data. Oracle Spatial development started halfway through the nineties and has been progressing steadily since. The current release – Oracle 10*g* – has added yet again number of features to the product, including topology.

Since the early days of Oracle Spatial, Bentley has been on Oracle's tail. Initially focusing on a two-tier architecture, with the connector strategy it raises the bar to the next level: a multi-tier architecture.

With its connector for Oracle, Bentley positions itself as one of the best alternatives in the market for maintaining Geospatial data in Oracle databases:

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– It faithfully extracts data without information loss, and posts back modifications. It supports all of Oracle Spatial native data types – a superset of the Open Geospatial Consortium's Simple Feature Specification – without superimposing its own standards or (technical) metadata. The Oracle Spatial topology model – introduced with 10g – is also supported.

– It leverages the power of Oracle's Workspace Manager, both in version management and conflict resolution. Thus enabling the implementation of truly controlled multi-user maintenance operations.

– It is a scalable solution, which can be configured to meet the requirements for tens to hundreds of users. Extracting of data can be configured according to the number of servers

– All process take place in a controlled environment, with the options to include the extract, modify and post sequences in workflows. In short, the Bentley Connector for Oracle is server software which provides a variety of services for the exchange of Geospatial content between the Oracle database and DGN content managed by the Geospatial Server.

The Oracle Connector architecture

The Geospatial Explorer is the client application used to order extraction or post operations to the Oracle server. The Connector then executes the requests and controls the exchange between the Oracle database and the managed DGN files. MicroStation GeoGraphics with XFM is used to view, capture or modify the content of the managed DGN files. By using the Connector to transfer geospatial content between the Oracle Spatial database and the Bentley Geospatial Managed Environment, the rich Bentley editing environment can be leveraged.

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