Leveraging Geospatial Information Across the Enterprise: Bentley's Flexible Geospatial Approach

A Bentley White Paper

Gijsbert Noordam
Senior Consultant,
Geospatial Center of Excellence

Bentley®
Sustaining Infrastructure

Introduction

The members of today's most efficient and effective project teams require instant access to all the business functions an enterprise can offer, regardless of which system the functionality resides within. This means that organizations cannot afford to isolate the business applications they deploy. Rather, they must connect all applications into a larger, integrated solution.

The focus of enterprise integration has traditionally been on connecting database-driven, form-based applications. However, for those organizations for whom geospatial information is critical, geospatial and GIS applications are increasingly being included due to the unique strategic value they add to business processes. This white paper discusses Bentley's flexible approach to geospatial enterprise integration.

The Need for Geospatial Enterprise Integration

In recent years, the subject of enterprise integration has been at the forefront of leading geospatial organizations. For many years, IT support for business processes largely involved buying new hardware and software, or hiring programmers to build applications – with the principle approach to remaining competitive being the purchase of additional software packages.

This strategy worked up to a point, but had a fundamental effect on the organization's IT infrastructure: every application implemented created its own legacy and dependencies. Without these applications, an organization's critical business processes cease to exist. In many cases, this has made it extremely difficult for organizations to replace old applications or even to implement additional new ones. A good solution to this problem is to apply an enterprise integration strategy.

Given the widespread need for geospatial enterprise integration, software vendors are expected to provide the means to make it possible. Bentley's software portfolio offers a number of geospatial enterprise integration options.

> The members of today's most efficient and effective project teams require instant access to all the business functions an enterprise can offer, regardless of which system the functionality resides within.

Four Entry Points to Integrating Geospatial Information Across the Enterprise

In today's information technology markets, almost every organization has a unique set of enterprise integration requirements. As such, a cornerstone of Bentley's integration strategy is flexibility. Its comprehensive geospatial architecture offers four entry points to geospatial enterprise integration:

1. Data (information) integration,
2. Integration with Bentley's geospatial desktop clients,
3. Integration with ProjectWise/Bentley Geospatial Server,
4. Integration with Bentley's geospatial publishing tools.

The first option focuses on ensuring that information in multiple systems is kept consistent. The other options offer a platform for process integration to link business processes across applications. And integration using Bentley's geospatial publishing tools also adds the ability to create a single, consistent front-end across a cluster of applications.

Data (Information) Integration

When the need for other enterprise integration goals is limited, data integration – to ensure that information in multiple systems remains consistent – might be all that is needed. Bentley's geospatial products offer two approaches to data integration:

- Data exchange – Bentley's geospatial interoperability tools can be used to exchange data in common GIS data formats like ESRI Shapefiles or MapInfo TAB and MID/ MIF; CAD formats such as DGN and DWG; XML-based exchange formats such as LandXML; or GML as the 'transportation vehicle.'

- Data collaboration – This is achieved by sharing one common spatial database using Bentley's geospatial desktop products as two-tier clients or *n*-tier clients in conjunction with the Bentley Geospatial Server.

Data exchange

Exchanging data through import and export – often using specially designed exchange formats – is a well-established practice. From long-standing formats like DXF to newer formats like GML, the principle is the same: export data out of system 'A' into an exchange format, then import the data into system 'B'.

A primary challenge of data exchange is to successfully carry over the syntax and semantics of the data from one system to the next. A good solution to preserve syntax and semantics is to natively support data formats from other systems – something MicroStation does very successfully with the DWG format. Another solution is to offer a flexible object modeling environment at the receiving end that can map the syntax and semantics of the data that is exchanged. This is what Bentley's geospatial products offer with their XML-based Feature Modeling (XFM) object model and interoperability framework.

Exchanged data offered to Bentley's geospatial desktop clients is dynamically mapped to the XFM object model they use. Once mapped, it is possible to customize the mapping definitions and store them in import and export XML files. Import and export paths that are fully mapped out create data exchange lifecycles. These paths can help formalize the way in which data in common GIS formats is sent and received between geospatial clients.

A primary challenge of data exchange is to successfully carry over the syntax and semantics of the data from one system to the next. A good solution to preserve syntax and semantics is to natively support data formats from other systems – something MicroStation does very successfully with the DWG format.

This figure illustrates the data exchange lifecycle between the Bentley geospatial desktop and a non-Bentley GIS client. The lifecycle leverages Bentley's semantic interoperability tools by using import and export XML files to map DGN/XFM objects to SHP data.

Many non-Bentley GIS clients offer the ability to exchange data using common GIS formats. Often, their import/export option is fairly rigid and data is exported and imported using a "one-size-fits-all" approach. Bentley Map, on the other hand, offers a lot of flexibility when exchanging data, for example, in data selection and sub-selection and when adjusting symbology. Rules for data exchange can be formalized using import and export XML files, creating the ability to exchange data both ways without losing any information.

Data exchange lifecycles work well when only one of the geospatial clients is allowed to modify the data at a given moment in time. Note that there is no transaction mechanism in place, so possible conflicts in data modification will have to be identified and resolved manually. When data ownership is clear and only extensive data exchange takes place, using the data exchange lifecycle approach may be sufficient. In other cases, however, more sophisticated data exchange methods are required.

Data collaboration

Data collaboration adds transaction support to the rich syntax and semantic model for data exchange used by Bentley's geospatial products. With transaction support in place, a robust data integration platform is created, allowing sophisticated collaboration among applications that previously were operating separately.

An important example of how the Bentley Map platform can collaborate with other GIS clients is its integration with ArcGIS.

In this use case, a common *Geodatabase* is used to store and retrieve data. The ArcGIS client accesses the common data store through its proprietary server architecture. Bentley clients either access the data store directly for read-only purposes, or use the Bentley Geospatial Server as the transaction manager for long transaction-based, read-write data access.
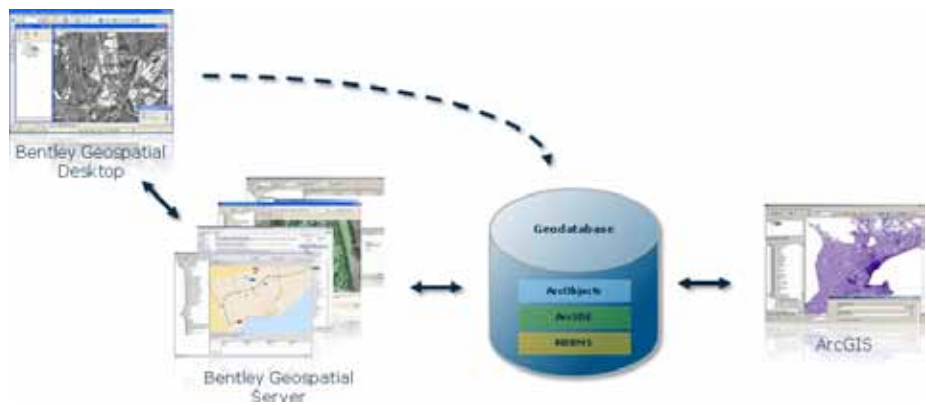
This diagram illustrates a collaborative environment that shows integration between Bentley's geospatial products and ArcGIS. The Bentley Geospatial Server offers n-tier access to a common Geodatabase with ArcGIS. In addition, direct read-only access to the Geodatabase is possible if the data is in an open format, as it is with Oracle.

Bentley's geospatial products support another approach to data collaboration: the use of Oracle Spatial or Locator as the common data store.

Here, Bentley desktop clients have a choice between directly accessing data in a two-tier architecture, or using the Bentley Geospatial Server for a scalable, multi-user editing environment based on Oracle's Workspace Manager technology. Any GIS client that — like Bentley — respects the transaction models provided by the Oracle database can be plugged in to create a data collaboration environment.
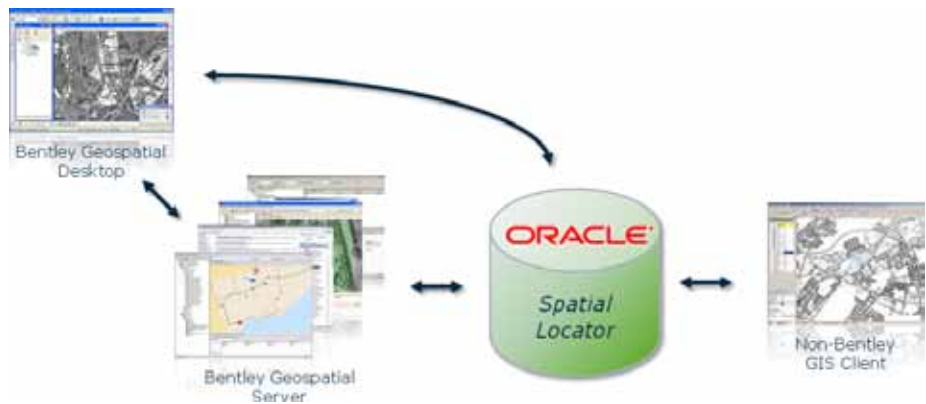
This diagram illustrates a collaborative environment that shows integration between Bentley's geospatial products and non-Bentley GIS clients using Oracle as the common geospatial data store. Both two-tier and n-tier access to the common data store is supported on the Bentley side.

Data collaboration is the enterprise integration model of choice when two or more GIS platforms need to be tightly integrated – not just to review data on either end, but for all parties involved to be able to modify and use the data throughout its editing lifecycle. It establishes a single data store with transaction-controlled data access.

Bentley offers this type of collaborative environment through its ProjectWise Connectors for ArcGIS and Oracle.

Integration with Bentley's Geospatial Desktop Clients

In today's information technology landscape, many desktop-based applications take care of a sub-task within more complex business processes, which may also use other applications. As a first step toward enterprise integration, organizations often start by creating point-to-point connections between applications.

To facilitate this type of integration between Bentley's geospatial desktop clients and other applications, two options can be explored:

- Customization – enhancing Bentley's geospatial desktop client using APIs to create an interface with other applications

- Common protocols – using ISO/OGC protocol-based functionality to interface with other applications
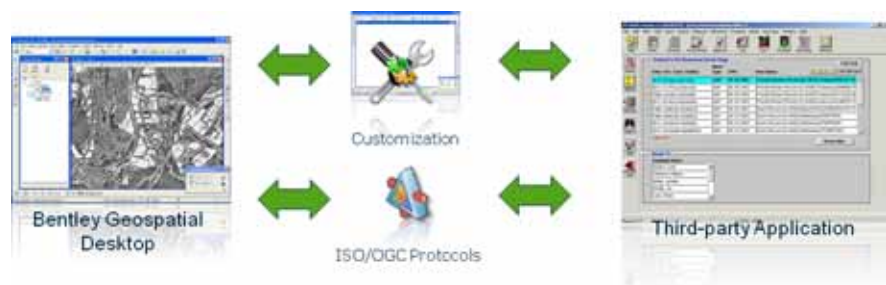
This figure shows integration with Bentley's geospatial desktop clients using customization or ISO/OGC protocols.

Customization

For many business processes, dealing with geospatial data is a critical for an organization. At the same time, the ability to interface directly with geospatial data is often only required during parts of a business process. A typical solution for this is a form-based solution with an interface to a GIS client. Due to the nature of form-based applications, such an interface is often customized.

If the scope of integrating business processes is limited, creating point-to-point interfaces between applications can work well. Bentley's geospatial products are designed to be customized, offering a wide choice of development environments including scripting, VBA, MicroStation Development Language (MDL), C++, and C#. Over the years, many successful interfaces of this kind were created by Bentley and its partners.

The moment the scope of integrating business processes widens, the complexity of the integration will exceed the development of point-to-point interfaces (the number of point-to-point connections grows in the order of the square of the number of points). Other strategies should then be explored. Even then, the ability to customize can prove to be extremely beneficial.

Using common protocols

There has been a steady increase in the creation and adoption of standards in the geospatial community. Whether this increase is from government agencies or groups of industry specialists, there is a boost in jointly defining IT standards to benefit us all. Within the geospatial world, one of the prime bodies of interest is the Open Geospatial Consortium (OGC). It is a non-profit, international, voluntary consensus standards organization that leads the development of standards for geospatial and location-based services.

A key advantage of using standards and protocols for enterprise integration is its breadth of scope. A protocol can be used for data exchange, but, due to its generic nature, the list of applications that potentially can support it is larger than the GIS-specific exchange formats. In many cases, the use of protocols can also replace customization, or make it far simpler. Another aspect of adopting protocols is that it can be a step toward vendor independence. With the right protocols in place, individual business applications can be replaced, without having to re-implement the business rules.

This figure illustrates the publishing of data using OGC's WMS and WFS protocols, serving either Bentley geospatial desktop or other OGC-compliant clients. Note how Bentley Geo Web Publisher services both types of clients and can act as a cascading WMS server, passing on WMS data received from other OGC-compliant web servers.

In recent years, Bentley's geospatial team has been actively pursuing the inclusion of OGC and other industry protocols into its product portfolio. Both its client and server products show a growing list of supported protocols and standards, including OGC protocols like WMS and WFS. In line with the geospatial community as a whole, more and more protocols will be implemented in the future.

Integration with ProjectWise/Bentley Geospatial Server

As Bentley's server platform, ProjectWise (and its geospatial cousin, the Bentley Geospatial Server) is the natural entry point for enterprise integration. For server-to-server integration, these products use Bentley's Connector architecture. This architecture ensures that a common transaction model is established between the Bentley server platform and the third-party server platform with which it integrates.

Two types of Connectors are available, and both are implemented as standard add-ons to the core server platform:

- Interoperability Connectors – they ensure that the Bentley server platform is able to interface with enterprise geospatial data stores. Implementing an interoperability Connector creates a collaborative environment between Bentley's geospatial products and an ArcGIS *Geodatabase* or an Oracle Spatial/Locator database.

- Enterprise Connectors – they provide an interface to other, typically nongeospatial, enterprise platforms. One of the most prominent enterprise Connectors allows for process integration between Bentley's server platform and SAP.
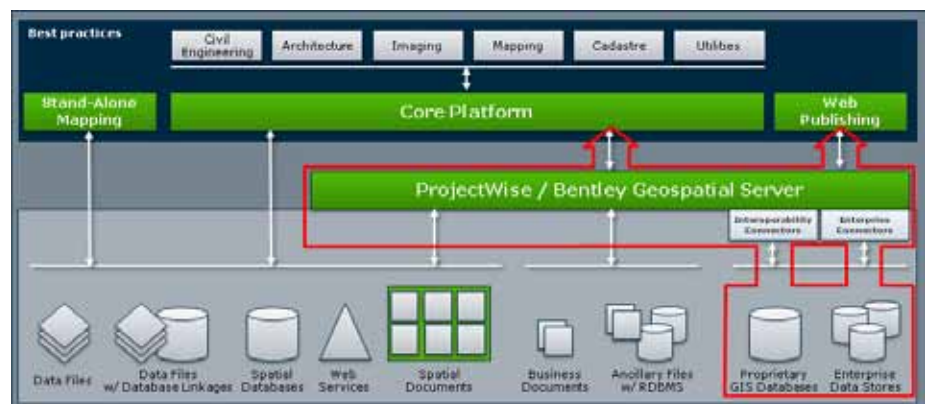

Interoperability and enterprise Connectors enhance ProjectWise and the Bentley Geospatial Server to provide bi-directional access to data in proprietary GIS databases and enterprise data stores.

A key strength of integrating with Bentley's server platform is that it offers a platform for federated data management. This allows different geospatial and nongeospatial environments to collaborate as one. Naturally, it also offers the ability to benefit from the strengths that Bentley's geospatial products have to offer. For example, when integrating with the ArcGIS platform, it is appealing to shift the data editing tasks to the Bentley side, with its comprehensive array of highly efficient and accurate data editing tools.

Integration with Bentley's Geospatial Publishing Tools

Where ProjectWise and the Bentley Geospatial Server focus on data management, the primary focus of Bentley's geospatial publishing tools is to present and use geospatial data, typically using web technology such as browsers or web services.

With the richness and diversity of the web-based world as a given, a key strength of Bentley's geospatial publishing tools is the range of clients it can service. This makes it easier to integrate into portals, mash-up clients, and enterprise platforms that use a web front-end. As such, the publishing tools are not only suited for process integration, they also 'blend in' the portal, mash-up client, or enterprise platform to offer the end-user a single interface.
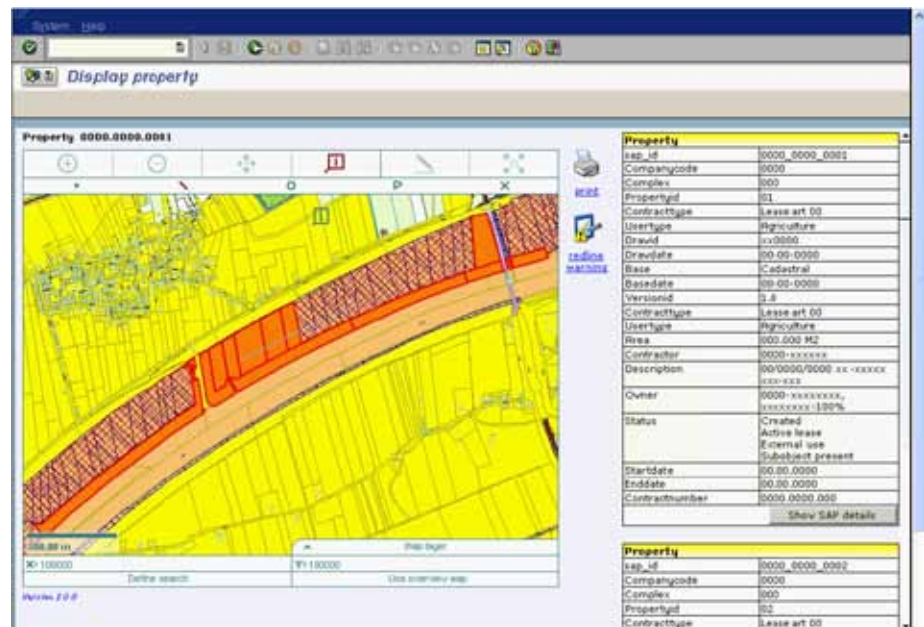
A Bentley geospatial client integrated into the SAP GUI to provide a common interface for graphical geospatial data and SAP form-based data.

The screenshot above shows the integration of a Bentley geospatial publishing client inside the SAP GUI. With this integration, the end-user is offered a single consistent interface, saving users from having to learn to interact with different software packages for a single task. With their support of many types of clients, Bentley's geospatial publishing tools offer flexibility in choosing the type of client that best integrates in a given cluster of applications.

Conclusion

The need for enterprise integration in many organizations is clear. Without it, organizations are locked into their current and past systems, unable to tie them together. Organizations face a specialized set of additional challenges and issues when geospatial information is a critical element of their enterprise information. Software vendors have an important responsibility to help organizations achieve their enterprise integration goals. Bentley's geospatial team takes that responsibility very seriously, and offers different entry points for enterprise integration. This is extremely important, because organizations differ and, therefore, have different enterprise integration requirements.

Every main purpose for enterprise integration is met by one of Bentley's geospatial enterprise integration options:

- When the emphasis is on *data (information) integration*, Bentley offers a syntax and semantically rich interoperability platform that leverages its XFM object model. Where XFM-based data exchange lifecycles are not sufficient, Bentley ProjectWise ArcGIS and Oracle Connectors take semantic interoperability to the next level to create robust, multi-user editing environments.

- Where *process integration* is the goal, Bentley positions its ProjectWise and Bentley Geospatial Server products as the federated environment that acts as the single point of truth across multiple applications, linking business processes. In addition, the fact that all of Bentley's geospatial products come with full APIs ensures that, when required, the 'last mile' in process integration can be reached.

- When it is about *vendor independence*, Bentley shows its commitment to open standards and protocols such as GML, WFS, and WMS, by continuously working on those standards that matter most to the market. By creating native two-tier and *n*-tier interoperability with Oracle Spatial/Locator databases, Bentley provides an open gateway to bring geospatial data to an industry-standard data store.

- When a *common interface* is required, Bentley's geospatial publishing tools offer a wide choice of geospatial clients, including WFS or WMS clients, Adobe Flash clients, and mash-up clients. Each of these can be easily integrated in a cluster of applications to provide a single consistent interface.

The keyword in the Bentley geospatial enterprise integration strategy is flexibility. It is encouraging to observe that this strategy works in a steadily growing number of enterprise integration implementations.

> Bentley's geospatial team offers different entry points for enterprise integration. This is extremely important, because organizations differ and, therefore, have different enterprise integration requirements.