Geospatial Web Portals

Jonathan W. Lowe

Imagine disparate departments being able to share GIS and related information, all through a customizable and secure interface — an enterprise GIS portal.

Years ago, companies such as Yahoo and Microsoft began publishing online catalogs of URLs (uniform resource locators) called *portals*, hoping the public would adopt their sites as entry points into the World Wide Web. GIS vendors such as ESRI followed with vertical portals (www.geographynetwork.com, for example) specific to spatial data. Corporate Webmasters now use the very same term (portal) to describe the recently popular, single sign-on, user-customizable Web sites that integrate and display data from multiple and otherwise independent sources. Some geospatial practitioners believe that the new portal technology is their opportunity to inject geospatial data and applications into the larger markets of mainstream information technology (IT). Are they onto something? This column explores the new portal technology and its potential relevance to the geospatial community.

What Are the New Web Portals and Portlets?

When online, how do you get directions to an unfamiliar address? How do you access a weather forecast? What about news? Movie listings? A dictionary definition? Some people pull each answer directly from a favorite bookmarked Web site. Others begin searches with a portal such as Yahoo (www.yahoo.com) or MSN (www.msn.com), diving into a category (for instance, games, health, travel) and clicking on links that access applications within a category. Numerous corporations and governmental agencies have also developed their own private portals to company- or government-specific information and resources. In each case, you're referencing a catalog of links to navigate the tangled chaos of the World Wide Web.

Today's Web portals have become more than just jazzed-up link directories, however. Instead of an index of hyperlinks, Web portals now act as a dashboard that consolidates multiple applications and datastreams served from both local and remote domains into a single Web page. These new portals know the preferences and privileges of users, allowing a visitor to log on and participate in a community sharing similar goals or interests. Web portals are also customizable and remember from one session to the next how each user has changed the layout and content of his/her portal.

A Web portal's building blocks are mini-applications called *portlets* — modular programs that do simple, specific jobs. One portlet may be responsible for displaying a calendar, another may query a stock exchange database, and a third may only be tasked with displaying a weather map. Each has its own self-contained user interface in the patchwork quilt of other portlets on a Web portal's overall page layout (see Figure 1). Portlets also support application-to-application communication, allowing developers to rapidly create business-specific composite applications from a library of portlets. So, though consolidated within its deceptively clean and simple footprint, any single portlet interface may actually combine data and tasks from multiple sources behind the scenes.

Portlet-to-portlet integration is also possible. Within a Web portal page, a user's actions in any given portlet influence not just the behavior of that target portlet, but of other portlets on the same portal page. For example, searching for a city name in a census statistics portlet might also cause the weather portlet to show that city's weather forecast, the news portlet to display links to local events, and the movie portlet to list local show times. Public portals such as MSN and Yahoo, whether equipped for user customization or not, already exhibit such integrated behavior. Given our industry's ongoing need for unification of disparate data sources and systems within a common geographic context, Web portals' integrative capabilities seem directly relevant to the geospatial practice.

Geospatial Portals

Specific to geospatial projects, portals answer the challenge of integrating and presenting data from paper records, isolated files, geodatabases, GIS software, nonspatial databases, and nonspatial applications (such as content management systems). Specifically, integration projects often require that actions in one proprietary application trigger changes in other proprietary applications. For instance, when one application closes a pipeline valve, another application should automatically notify all customers in that closed pipeline's service area. How can those two applications trade information? Desktop GIS software vendors sometimes attempt to solve common interapplication unification problems by supplying data

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translators or application "bridges" between their desktop products and external data or processes. But more often than not, the only viable approach to such integration problems has been to develop sophisticated custom code in both applications to exchange messages across the gulf. When the spatial applications and databases run on different operating systems — Windows, Unix, Linux — the challenge is even greater.

The recent maturity of Web-portal software provides a new approach to geospatial application integration. Since all portlets in a portal follow the same model — essentially eXtensible markup language (XML) content exchanged via hypertext transfer protocol (HTTP) — any Web service or "digital feed" that fits the model can be part of the same Web page. Maps served by an Intergraph product can sit cheek-to-jowl with maps served by ESRI software. Few databases remain that do not support some kind of direct Web-services access method, thereby opening the portal playing field to databases as well. And because many business applications (such as for electronic document management, enterprise resource management, and asset management) have openly published APIs (application programming interfaces), even critical enterprise-scale business processes are candidates for inclusion into a geospatial Web portal.

Developers report that a major advantage of integrating data and applications through a Web portal (rather than custom coding) is the portal's inherent reliance on IT standards such as Web services, XML, and HTTP. In fact, as far as the portal is concerned, it makes no difference whether a dataset (geodatabase or otherwise) is hosted on a Unix/Oracle platform, a Windows/SQL Server platform, an open-source alternative, or any other combination. Just stick to the XML and HTTP standard.

Putting GIS into the Hands of Users

Because they also rely on single sign-on standards, Web portals can keep track of who belongs to which communities and exactly which privileges each user enjoys within each community. As the administrator, you may have the right to edit spatial and nonspatial data, while a colleague may be limited to editing only tabular data or simply viewing the data.

Additionally, thanks to Web portals' recognition of each user's identity, individuals can tailor what information appears in their portal and how it is laid out on the page — whether that data is fed from a legacy database, document-management system, geodatabase, or an Internet-based application. Knowing who's who enables data owners to maintain local control without curtailing enterprise access. A county planner who needs to consolidate information from a variety of sources can do so with a portal, but without needing the data suppliers to establish any centralized common infrastructure. To get first-hand experience with just such a geographically enabled portal, I visited Farallon Geographics in downtown San Francisco. Farallon's CEO, Dennis Wuthrich, presented an assessor's parcel portal that integrated property maps, permitting, property valuation, and land-use planning from several different departmental databases. Farallon uses software from Plumtree to build its geospatial portals.

From a Web portal containing a parcel-map portlet and several tabular portlets (see Figure 2a), Wuthrich clicked on an individual parcel. As with a typical Web site, the page disappeared for a split second and was replaced by a fresh page in which the selected parcel was highlighted. All of the other portlets had changed as well — one showing detailed ownership for the parcel; another a list of which voting precinct, police beat, and city-council district surrounded it; and another with metadata about the parcel's generation and maintenance (see Figures 2b and 2c).

Likewise, when Wuthrich changed a tabular value in another portlet by editing one of the numbers in the assessor's parcel identifier, the page again refreshed with changes to all portlets, including a new selection on the map. This illustrated that the links between spatial and tabular, or more precisely, between one portlet and any of its other portlet comrades, are bi-directional. Change any to change all.

Conceptually, the mechanism behind portlet-to-portlet integration is quite simple. Portal developers set up their portal servers — middleware that filters browser requests and returns portal pages — to recognize data or keys common to more than one portlet. For instance, in Farallon Geographics' portal, the mouse click on a map parcel triggers a message to the Web server with the selected polygon's assessor's parcel identification (ID) number parameter; call it *APN-ID 666*. A map server somewhere in a county office receives the APN-ID and returns a new map image with parcel 666 highlighted.

Elsewhere, an entirely different machine running a database also waits for a parcel number. Send that machine an APN-ID, and it will return purely tabular parcel details, such as owner and property value. Unfortunately, this second machine expects the parcel number parameter to be called *PID*, rather than APN-ID. Traditionally, these two databases would not

Figure 1. The site http://my.yahoo.com illustrates the most common features of today's portal technology: single sign-on, user customization, options to add or remove individual portlets, control over portlets' content, and portalwide integrated content. Visiting a weather link for New York triggers updates in related portlets, such as location-specific real estate and hotel advertisements.

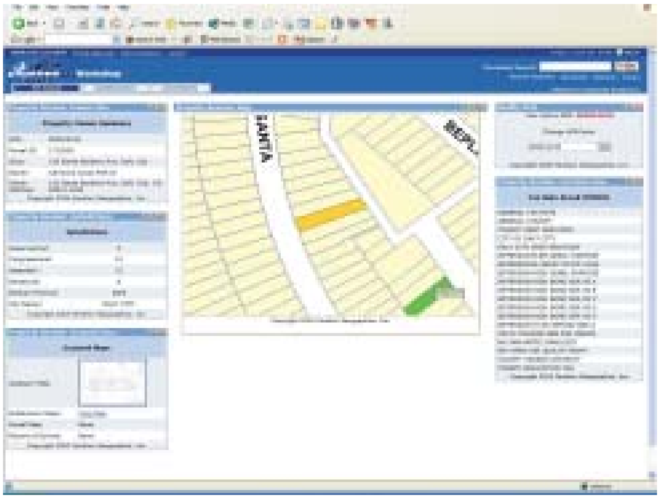

Figure 2a. Farallon Geographics' Parcel Portal draws related spatial and tabular information from disparate data sources.

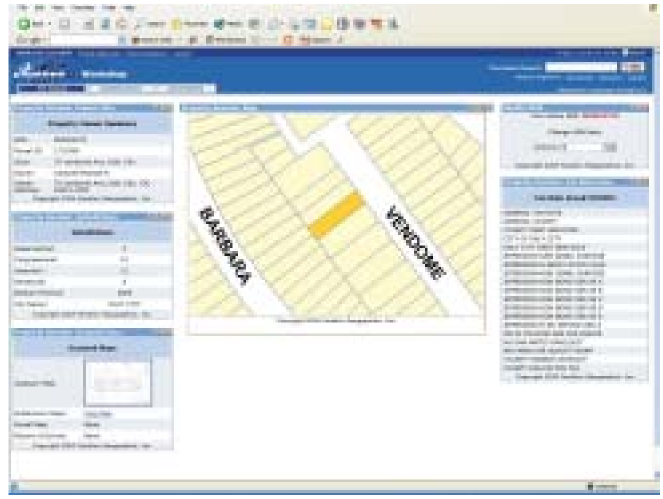

Figure 2b. Tabular searches and map selections within each portlet adjust all other portlets in the portal. In this example, a map click updates both the map image and tabular contents of surrounding portlets.

communicate, but this is where the portal server lends a hand. Consulting its alias list to discover that APN-ID on the map server equals PID on the database server, the portal server translates and sends PID=666 to the database server while simultaneously sending APN-ID=666 to the map server. Assuming that both machines respond, the portal server populates both portlets with graphic or tabular results. Governed by the portal server, the same sort of common key translation also happens for all the other portlets in the portal. Changes ripple through the whole integrated page.

Figure 2c. Some users might not care about jurisdictions and can minimize the portlet containing that information without disturbing the portal's other functions. The portal server remembers these choices later when a user returns.

The Benefits of Portals

At first glance, this sort of unified data display isn't a revelation to anyone who has worked in a similar environment at the desktop, or even to a spatial Web site developer. In a desktop environment, ESRI ArcView users are well-versed in selecting points in a map view and seeing associated tables, charts, and graphs automatically redraw that new data selection. Likewise, in a Web browser, map features and their associated attributes can be linked in the same dynamic HTML page, exclusive of any portal technology. But there exists a fundamental difference: desktop GIS users and even Web developers interact with a computer network actively managed to support connections to databases (and other resources) that have been customized to meet their needs by an administrator or coder. Portal users access services (geospatial and otherwise) without needing to understand the underlying structure of the database or its location and platform. In other words, portal users access specifically interpreted information rather than raw data. They would choose to access a thundershower map portal built from a collection of weather-information portlets rather than a database table called "storms" on the region's aviation server (see Figure 3).

There's also the benefit of easy reuse, even by nondevelopers. The tools for customizing a Web portal's graphical user interface (GUI) do not require computer-programming skills — a Web-based wizard or simple construction menu makes portal GUI design widely accessible (see Figures 4a and 4b). Customizing a portal GUI involves first deciding the overall layout, such as dividing the Web page into one or more columns. Designers then select from a list of portlets and choose which appear in each column. Portlets can be mixed, matched, and reused in as many different portals as needed. For example, several different geographic portals might all reuse the same small-scale context map portlet.

Because popular portal business services, such as search engines, interaction management, content management, maps, and collaboration, are preintegrated, they can be rolled out incrementally with minimal risk. The result is the ability to quickly achieve return on investment from an initial deployment and later roll out further functionality, spreading the cost out over time.

This design approach assumes that there are plenty of portlets waiting to grace your Web portal's layouts. The more specialized the portal, the less likely that pre-existing portlets are ready to plug and play. Though a developer is required when turning a standard Web page into a portlet, the process is reasonably simple. Building a Web service, geographic or otherwise, also requires developers. Finally, if the portal uses the integrated portlet-to-portlet communication approach (as the Farallon Geographics example does), the developer must identify those common key relationships to the portal server. Once built, however, reuse will theoretically offset the upfront development cost of creating portlets in the first place.

Packaged portal server solutions range in price from $4,000 to more than $125,000, plus client licenses. Successful portals return their investment capital by saving time previously spent consolidating disparate data, eliminating duplication of effort, improving security, and disseminating information to a broad constituency of internal and external users. Because Web portals are relatively new to the geospatial industry, retaining an experienced enterprise GIS integrator with previously implemented portal solutions is recommended.

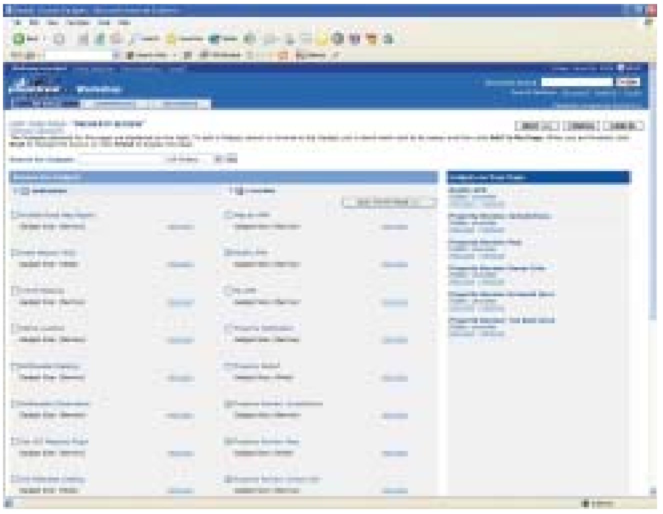

Figure 3. Portlets are information brokers rather than raw data sources. When building Web sites, portal designers can select from lists of available portlets, as illustrated by this backend administrative interface from Plumtree.

Portal Philosophy

The technical basis for portals and their shortcuts and efficiencies may interest the technicians among us. To an executive such as Wuthrich, however, a portal's greatest value is in securely unifying the content of formerly uncooperative departments with minimal changes to operations. "In the parcel portal," he explains, "imagine that the parcel server and voting precinct server are managed by independent departments that historically have refused to share data. Now they don't have to share, replicate, or exchange data at all, if they can agree to publish geodata through a Web service. Their data and applications remain in their control but permit specific question-and-answer exchanges, such as, 'What precinct contains this point?'" In the framework of portal technology, Wuthrich has observed customers' conversations shifting from "I'll give you a little bit of my data if you give me a little bit of yours," to "What's the business problem we're going to solve?" Any software that encourages such a fundamental shift in attitude is worth serious consideration. ⊕

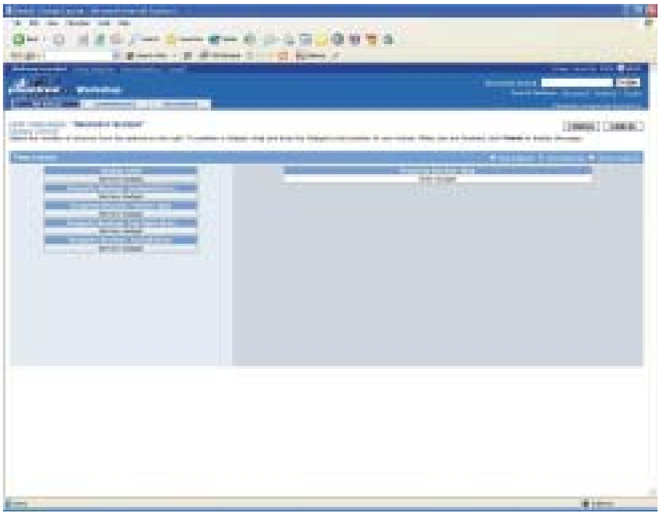

Figure 4a. Nondevelopers can control portlet placement within a portal's layout using online tools such as this portal arranger by Plumtree.

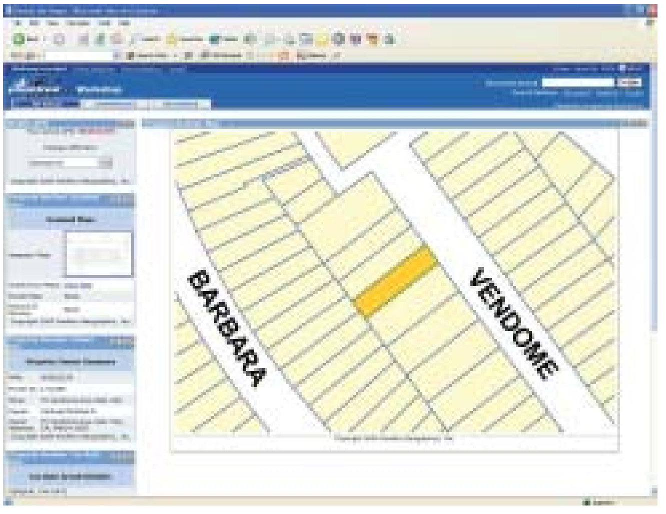

Figure 4b. Moving most portlets to the left side of the layout frees up extra room for the mapping portlet that was formerly sandwiched between textual portlets (see Figure 2).