GIS Technical Environment Overview
February 29, 2008

A major concern for GIS professionals is how to support the vision of a federated geospatial community where the key to success is the ability to deliver the correct information, to the proper location, at the right time. The question addressed in this paper is just that; from a conceptual perspective, how will the State technically support the goal of efficiently discovering and delivering physically dispersed data?

Background

As visualized, the Montana Base Map Service Center (Center) is not just a physical entity but more importantly, a virtual federation of data creators, data storage facilities, portals, information disseminators and information consumers. The Center concept envisions the responsibility for base map layers residing with the GIO and for non-base map layers with the producer of that information, and for the implementation of the State's primary Clearinghouse (i.e., Discovery Hub) and Data Warehouse within the Montana State Library (MSL) and the Department of Administration/Information Technology Services Division (ITSD), respectively. It anticipates the ability to locate data anywhere within the federation network and deliver that geospatial information to the consumer via Delivery Hubs (e.g., sets of web services) when, where and how they need it.

Federation Technical Environment

There must be the ability for all public and private information consumers to enter the network from any location and be directed to the most authoritative source for the information they seek; at any single point, the network must know exactly who has what data, the quality of that data, and how to best get it. The task of maintaining this metadata (i.e., registration, location, delivery, contents, etc.) is huge and provides the basis for the critical work of the State's GIS portal (Discovery Hub). Therefore, providing strong management control and professional commitment to this building block is fundamental to any sound technical environment.

As recommended in the 2006 GIS Common Operating Picture (COP) Report and concurred with by the State's Geographic Information Officer (GIO), the responsibility is centered in the MSL. Funding for the State's GIS portal project was authorized during this biennium and the hub is currently being built under the direction of the MSL using ESRI's GIS Portal software.

One particularly important aspect of the Discovery Hub effort is the registration of datasets. Registration is the ability for authoritative information sources to self-determine whether and under what conditions, they wish to publish their data to the rest of the federation. For example, DEQ may decide to publish their Abandoned Mines dataset to the federation. However, because of 'National Historic Preservation Act of 1966' concerns, they may also want to restrict the use of this information to certain applications

and/or interpretations. When DEQ publishes the registry information necessary to access their Delivery Hub of choice for this dataset to the MSL Discovery Hub, they would include any restrictions deemed necessary. Anyone wishing to use the data would know what, where and how (under what conditions) they might use that Abandon Mines information.

While the "where", "what does it look like" and "under what conditions" can be tackled via metadata and registration within the Discovery Hub, the "how do I get it" is best addressed through multiple web-based services (i.e., Delivery Hubs). The critical nature of the MSL portal has already been discussed, but suffices it to say, it functions as the broker; the application that passes requests for information from front-end applications to the appropriate Delivery Hub.

Web-based services are those vital "middleware" applications whose purpose is to field the requests, obtain the data from the appropriate source(s) and pass that information back to the front-end (i.e., consumer's) application. In order to provide secure, consistent and cost effective information access to multiple data sources, federation management control over these geospatial web-based service applications are another strategic element to any healthy federated network.

Therefore, the second fundamental building block is the use of Delivery Hubs to obtain data from the most authoritative source(s) available and deliver it to the front-end application (i.e., requestor) for processing. Each service must be registered, discoverable, interoperable, functional and scalable. Within a federated GIS, these services comprise Delivery Hubs, and the State entity best suited to establish the standards and manage their adherence is the Base Map Service Center.
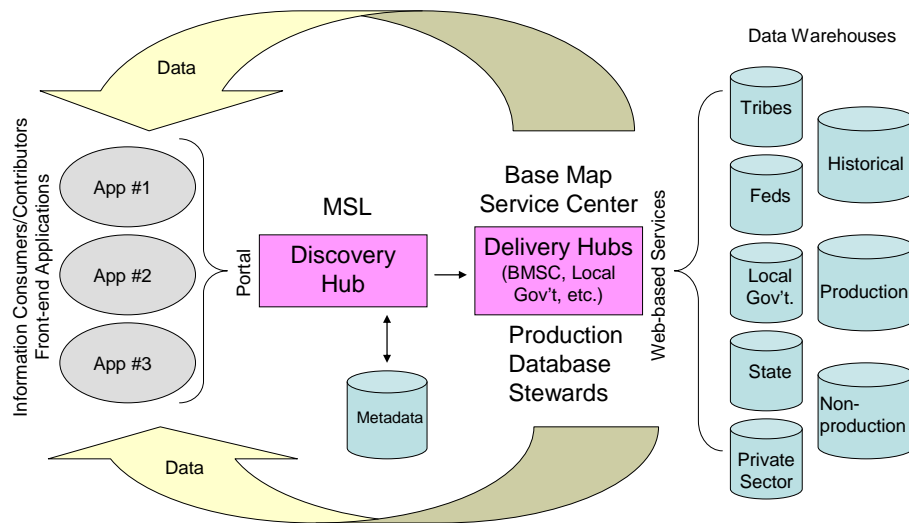
However, this is not to say that all data discovery, dissemination and/or data warehousing resides in one of these two entities. The importance of other public and private purveyors of information cannot be overemphasized. The power of a federation is its ability to collect quality data, retrieve information from the most appropriate source and distribute those records in the most efficient way possible. While the key is still to have information available (i.e., registration) about where the best data (information that is current, complete and correct) is located, how to get it and the services that deliver that information using standard methodologies, each and every federation member must be regarded as both a consumer and potential source (contributor) of quality data. A key capacity of the federation is realized only when partners follow standards and protocols that allow each member to take advantage of this symbiotic relationship.

One advantage of the multi-tiered approach of separating the front-end application, from the broker, from the information obtainer, and from the database itself is that when one of the components changes not all functions have to change. That is, the vision creates simple, quality sub-tiers (e.g., Discovery Hub) that use standard interface protocols to solve a complex program (i.e., federation). In addition, it simplifies developing and maintaining data calls because the middleware services adhere to one set of standards. Further, managing these services fashions a group of loosely coupled IT professionals

whose sole purpose is to provide geospatial data to front-end applications, thereby freeing front-end application developers to concentrate on designing programs that best serve their organization's business need. Additionally, it adds another layer of security by limiting direct access to backend databases. Creating priorities within each service also helps the federation balance workloads and adjust computing resources to accommodate increased demand.

Below is a graphical representation of the technological environment. The illustration does not intend to represent every server, router or network node, but give a more general concept of how the independent, federated pieces of the puzzle fits together. The uses that entities make of the Discovery and Delivery Hub services will vary from organization to organization. They may support a public dissemination services provided by MSL (e.g., Montana Digital Atlas), a DEQ internal business process (e.g., issuing environmental permits), a private company's value-added service, or any number of other products and services requiring geospatial data.

GIS Federated Network

Data Control, Access and Customer Support

A concern of many within the GIS community is who controls the data, how is access provided and what they do if they need assistance. The answer to all three questions is "it depends". A strong point of the federation is its ability to provide for control over data by the stewards/producers of that information, yet still offer access methods that allow any member of the federation/public (assuming proper security) to obtain data for their applications. If data control and functionality are distributed, then support must be, at least to some extent, distributed.

As stated above, for the federation to be successful, data must be discoverable. That has several implications. Information sources are registered, the consumer must have information on how to obtain the data, and there must be standard metadata available. In the federation, the Montana State Library (MSL) will fill this role.

The federation role of the Base Map Service Center (BMSC) is to ensure that authoritative sources (current, complete and correct data that is as close as possible to the data's natural producer/maintainer) distribute data in an efficient manner, are easily discoverable (MSL Discovery Hub), provide efficient access (Delivery Hubs), and provide help functions. There is no assumption that the BMSC has physical or management control over the data. However, for base map layers, management control lies with the BMSC unless delegated to intrinsic custodians (see BMSC concept paper for definition) by the GIO. For production layers, management control is the responsibility of the data producer unless they select to delegate that authority. Historical data (e.g., older "copies" of data used for research into past circumstances) is the responsibility of MSL.

Depending on the question, assistance will rely on a tiered approach with the portal being the first and the component "owner/manager" being the last line of support. For example, if the question concerns use of the Discovery Hub, MSL will provide support. If it has to do with the retrieval of information from one of the Delivery Hubs, that Hub owner is the best source of information. All of this should be documented in MSL's portal such that if consumers cannot get answers from an automated help page (e.g., Knowledge Base), there is information on how to automatically bridge to the next level.

Summary

The vision for a Federated Montana GIS is deep-seated. While discussions concerning funding may continue down several venues, the need to determine a long-term technical architecture supporting the multi-partner, federation remains constant. Identification of concepts such as the Discovery Hub, Delivery Hubs, and the creation of the BMSC are all first-step building blocks in Montana's evolution to a model that delivers the correct information, to the proper location, at the right time. To achieve this, we must move forward with those standard technical elements that support that vision, the entire Montana GIS community is expecting the GIO and the Council to ensure this goal is met; an assume responsibility but one that is central to the very fabric of our future.