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Empowering People with Spatial Solutions

State of Minnesota
Enterprise GIS Opportunity Assessment

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1 Introduction & Context

The following presents a high-level overview of the opportunities that exist to deploy GIS services and activities at an "enterprise level" for Minnesota. This overview is designed to provide a preliminary look at what Minnesota's enterprise GIS might grow to look like. Among other things, this preview of the enterprise GIS "end-state" is designed to help inform the ongoing discussions of the governance model that will be required to manage it.

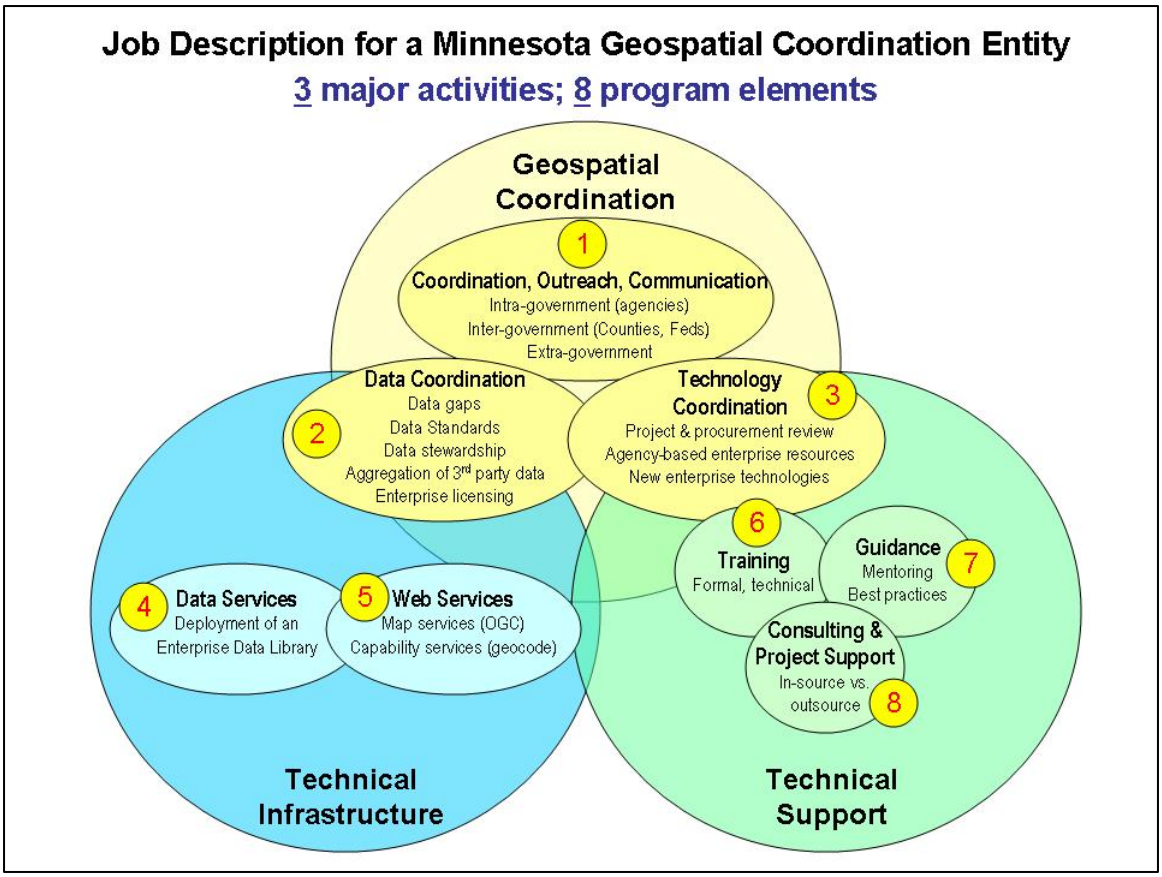
The enterprise opportunities presented in this document were developed following the completion of 20 state agency interviews, conducting a non-state GIS stakeholder workshop, and with reference to relevant approaches followed by other states. These information gathering activities helped identify and prioritize the GIS coordination and enterprise GIS capabilities that are of greatest need to Minnesota state government.

Both the Strategic Planning Sub-Committee of the Governor's Council on GIS and the Drive to Excellence GIS Project Steering Committee have reviewed this document and have provided both input to and an initial endorsement of its content. During August and September of 2008, this document will be expanded to add greater detail, and refined to present a cohesive set of recommendations for transforming state government GIS activities and capitalizing a state government-wide enterprise GIS approach. With the general approach described in this document, the final detailed document will be further informed by targeted research into the approaches and best practices taken by other states that have pursued similar approaches for individual elements of the overall plan.

2 Minnesota Enterprise GIS Requirements & Activities

The following presents three major categories, and eight distinct sub-categories of "enterprise GIS activity" that Minnesota can expect to build and/or refine as GIS operations are transformed as part of the Drive to Excellence initiative.

The image below illustrates the overall program, and the sections below provide additional details on each major category and program element.



I. Leadership and Coordination

Program Element #1: Coordination, Outreach & Communication

As documented in the interviews, the non-state stakeholder workshop and in previous GIS planning efforts, numerous *ad hoc* efforts to provide GIS coordination have preceded the current initiative. The 2004 report A Foundation for Coordinated GIS noted the strong "collaborative culture" and the 2007 report about the Compass Points retreat noted a "long history of collaboration and partnership."[1] That said, providing GIS coordination has not been identified as any one entity's *formal* responsibility. As the Compass Points document bluntly put it: "everyone is in charge, therefore no one is in charge."

As documented by Compass Points, Minnesota has discovered that informal coordination can only take an organization so far, especially in an environment where the use of GIS technology is exploding. The days of all GIS stakeholders knowing one another and bumping into each other regularly are over and this puts strains on the "collaborative culture." Equally, the lack of coordination is leading to missed opportunities and some redundant efforts.

[1] Both reports are posted on the Enterprise GIS Drive to Excellence web site at http://www.gis.state.mn.us/committee/MSDI/dte.htm.

State government has a **business requirement** to actively communicate and coordinate GIS activities of state agencies and, as a major stakeholder, with other GIS stakeholders in other levels of government, in academia and in the private sector. The volume of ad hoc coordination efforts validates the need for more formal coordination. GIS is inherently interdisciplinary and the state fundamentally requires data that are created and maintained by other organizations, and vice versa. It is time for this business requirement to be acknowledged, formalized and resourced. States such as Massachusetts or New York have recognized this and maintain formal "GIS coordination programs." Formal coordination will principally take on three forms:

A. <u>Intra-governmental coordination between state agencies</u>. In order to realize some of the benefits described below (principally in sections 0 and 0) the state needs to actively promote and orchestrate agency-to-agency communication and collaboration. There are several broad benefits that such coordination should yield:

- Pursuit of co-funding of significant investments (e.g. statewide orthophotos)
- Development of communal resources available to all agencies (e.g. web services)
- Lower barriers to entry, and assistance to agencies commencing GIS for the first time
- Removal of redundancy (e.g. overlapping, ad hoc inter-governmental coordination efforts)
- Increased awareness of GIS initiatives and programs throughout state government.

Specific intra-governmental coordination activities can be expected to include, but are not limited to:

1. **Strategic plan guidance and implementation.** A coordinating entity would be expected to work with stakeholders to develop, guide and implement a strategic plan for making GIS resources and services available throughout state government. This project represents an important milestone in building enterprise capacity for the enterprise, but the state will need to sustain the planning process beyond this project.
2. **Policy, legislative and budget coordination.** A coordinating entity can provide the essential leadership to work with agencies to identify common requirements and opportunities for collaborative projects and funding, identify mutual requirements for legislation that would clarify GIS responsibilities and/or provide funding for GIS initiatives, and take the lead in presenting and managing legislative and budget initiatives through the legislative process.
3. **Identification and promulgation of agency best practices.** A coordinating entity would be in a position to identify and inventory state agency *geospatial best practices* that can guide the efforts of other agencies pursuing similar projects. In addition to identifying the practices, the coordinating entity can help promulgate and broadcast such practices across the enterprise. An example of a

best practice that may have wide applicability to a variety of agencies would be "data stewardship" practices for GIS layers.

4. **Support for governance entity and user groups.** A coordinating entity may also provide staff support to the GIS Governance entity (i.e. the Governor's Council on GIS, or a successor organization) and internal GIS user groups (e.g. the existing State Agency GIS user group, SAGIS). Staff support may include scheduling and coordinating meetings and taking on tasks identified by these bodies. In addition, the coordinating entity may catalyze the formation of additional user groups and/or communities of interest (e.g. Open Source GIS user group). The coordinating entity would not necessarily lead such user groups, and there may be distinct advantages to having agency staff lead such efforts, but the coordinating entity could provide valuable logistical support to make these groups more effective. Nurturing such users groups would be an important tool in building a state government user community and fostering an ongoing, collaborative spirit.

5. **Identify opportunities for intergovernmental collaboration and leveraging existing geospatial resources.** By tracking geospatial activities across the enterprise, the coordinating entity would be in a position to identify where opportunities exist for multiple departments to pursue joint projects that both meet agency needs and help build enterprise resources. Equally, the coordinating entity can help guide agencies newly involved with GIS technology towards departments that have geospatial resources or experiences to share.

B. <u>Inter-governmental coordination between the State and other government levels</u>. The state already is communicating, coordinating and sharing data with partners at the local, county and federal levels of government. However, much of this occurs at the agency/departmental level, and there can be duplicated and overlapping efforts. While departmental level communications will need to be maintained, for certain activities -- such as collecting local government data sets -- it makes sense to do it once "for the enterprise." In addition, some partners, such as the Federal Geographic Data Committee (FGDC) are actively trying to identify a "coordination entity" for each state to improve the federal government's coordination practices. Such an entity should be formally recognized in Minnesota.

C. <u>Extra-governmental coordination</u>. In addition to coordinating with other governmental stakeholders there are clear needs to coordinate with academic and other private and non-profit sector GIS stakeholders. Examples of extra-governmental coordination activities might include:

1. Working with **utility companies** on data sharing agreements for their infrastructure data to support planning and emergency preparedness (while respecting the sensitive nature of those data sets)
2. Working with the **academic community** to provide training, technical guidance and project support as described in Section III.
3. Enlisting **private sector** GIS service providers to utilize state GIS standards, particularly in work done for local governments

4. Understanding how the state's GIS data and infrastructure supports **non-profit** entities engaged in public policy issues

Program Element #2: Data Management Coordination

In spite of Minnesota's relatively strong statewide data holdings, there remain some significant data gaps (e.g. elevation data) and opportunities to improve data. In addition, some data sets (e.g. municipal boundaries) have no clearly identified custodian in spite of broad, multi-agency needs. Finally, because a number of state agencies procure some of the same commercial data sets, opportunities exist for more favorable enterprise licensing.

Ultimately, many agencies (if not *all* agencies) suffer from these data gaps and could benefit from activities such as pursuing enterprise licensing for commercial data sets. As such, a transformed, enterprise approaches to GIS should fulfill the following data management coordination roles:

A. Fill data gaps. Fill data gaps through project design, coordination and advocacy for multi-agency funding to meet common needs (e.g. statewide, high-resolution elevation). States such as Iowa and North Carolina have embarked on statewide efforts to develop high-resolution elevation data and Minnesota is in the planning stages of such an effort.

B. Manage recurring data programs. Address need for recurring data investments through project design, coordination and advocacy for multi-agency funding for data programs such as a regularized orthoimagery program. States such as New York and Pennsylvania have successfully designed and implemented recurring programs for regularized, statewide orthoimagery.

C. Improve data standardization. Oversee the creation, implementation and evolution of appropriate data standards. Minnesota has some existing standards, but the increased level of geospatial activity and increased levels of intergovernmental coordination and collaboration make standards increasingly important. Ultimately, there is a need for a broad array of standards that cover elements such as data content, data accuracy, metadata as well as physical schemas for data structure.

D. Collect and aggregate data. Provide the lead for the collection and aggregation of local/county data sets, such as parcels, including the completion of "enterprise" data sharing agreements for all of state government. Several agencies, including DNR and DOT, have pursued this activity for their own purposes and many more are interested in the resulting data. Clearly, this major effort should be completed once on behalf of the enterprise.

E. Executive enterprise data licenses. Execute favorable state enterprise licensing for data products that are used by multiple agencies (e.g. commercial road centerlines, demographic or business location data sets). Interviews have documented several cases where different agencies have independently acquired the TeleAtlas street centerline data. Other states have completed "enterprise" licenses for commercial road centerline data that not only extend to all of state government, but also to local governments (e.g., Massachusetts with NAVTEQ, and New York with TeleAtlas).

Massachusetts has also obtained statewide licenses of Pictometry oblique imagery that extend to all state and local government entities. Following the same idea, the Metropolitan Council has acquired an "enterprise license" for street centerline data for the seven metro counties from the Lawrence Group (TLG); more than 100 government entities have taken advantage of this license.

F. Coordinate data custodial functions. Provide the lead for identifying data custodial responsibilities for data sets which may not have a formal, agency custodian (e.g. municipal boundaries). As required, the coordination entity may need to take on, or arrange to contract for, the custodial responsibilities for "communal data sets." Other activities might include advocating for legislation to identify custodial responsibilities[2] for data sets, and documenting and tracking the data custodial responsibilities that are assigned and recognized. There will remain some data sets that are of broad interest but for which no authoritative source and/or custodial responsibility exists (e.g., critical infrastructure). Identifying a coordination entity for statewide data provides the opportunity to both highlighting and addressing these shortcomings.

Program Element #3: Technology Coordination & Leadership

As with most states, GIS has "grown up" organically and opportunistically in Minnesota with several "lead agencies" independently and simultaneously developing impressive departmental enterprise systems. While this appropriately reflects the state of the technology over the past three decades, there is great potential for GIS to be better coordinated and more efficient. This is particularly true for an increasing number of agencies, such as Human Services, that have only recently initiated GIS programs. New adopters can learn from the technology leaders and new opportunities will exist for agencies – even those with mature systems - to share baseline GIS infrastructure. To help make this happen, a GIS coordinating entity should have the capability to perform and/or expedite several *technology coordination* activities, which might include:

A. GIS project review. Project review would identify opportunities for cross departmental synergy as well as existing use cases and best practices within state government that project proponents could learn from. The idea is not to create a bureaucracy that has "approval authority", rather the idea is to foster communication that can identify opportunities for collaboration, and can provide early warnings for redundant initiatives. In addition, as the state strives for efficient deployment of geospatial technology, this type of review process helps the state to visualize and manage the full and growing portfolio of geospatial activity.

B. GIS procurement review. Improve the effectiveness of State investments by tracking the technologies that departments are investing in and identifying opportunities for potential enterprise licensing and/or existing excess capacity that could be utilized. As with the project review process, this type of review does not necessarily imply an approval process. Rather, it provides the opportunity for the state to better understand its expenditures and track its portfolio of GIS equipment, software and data.

[2] Utah has legislation that clarifies the responsibilities for mapping municipal annexations.

C. Geospatial integration with other enterprise systems. Increasingly, many commercial, enterprise systems include "GIS modules" that provide the ability to geospatially enable those systems. Two current Minnesota examples of such systems are *DisasterLAN* which is being deployed in the state's Emergency Operations Center (EOC) and *Archibus* which is being deployed by the Department of Administrations as part of their Drive to Excellence Property Management project. Such systems will have specific requirements for GIS data and connectivity in order for those modules to properly function and the coordinating entity can help provide GIS support to agencies pursuing the deployment of these types of software systems.

D. Identify enterprise Centers of Excellence. As described above, many departments have extremely mature GIS operations and provide GIS technology leadership. In some cases, these departments may be able to act as "enterprise resources" that provide capability/service to other departments thereby leveraging existing resources and expertise while minimizing redundancy. Examples of existing agency capabilities that have the potential to be identified as "centers of excellence" and to be scaled for the entire enterprise include:

- DNR's "Data Deli" and LMIC's Geographic Data Clearinghouse for public dissemination of geospatial data
- MnDOT's ArcGIS Server application hosting infrastructure
- DNR's Open Source web service hosting infrastructure
- LMIC's image hosting and image service infrastructure

While this *potential* exists, it is important to understand that agency personnel have a primary responsibility to their own organizations. Thus, it can be easier to make surplus computing capacity available than it can be to make personnel available. As such, if this approach is taken it will be necessary to develop tactics for enabling the agency center of excellence to have the staff necessary to interact with and support the requirements of other agencies. For example, it might be possible to have "coordinating entity staff" embedded within agency centers of excellence providing support to other agencies with an "enterprise outlook."

E. Identify enterprise approaches for new technologies or application areas. Many new geospatial technologies are emerging or being adopted, such as mobile device GIS applications and automated vehicle location systems. Currently, individual agencies are investigating and/or deploying these new technologies independently. As such, the potential exists to deploy these new technologies with enterprise approaches from the outset. This would include identifying opportunities to pool agency resources to meet common and enterprise needs. Similarly, there may be common needs for new applications – for instance, real property tracking and asset management - that span multiple departments. While the geospatial "project review" and "procurement reviews" should help to identify these opportunities, there may also be an opportunity to effectively support the project design and execution for these types of enterprise initiatives in association with lead agency personnel.

II. Technical Capacity

In addition to the coordination elements described above, a transformed, enterprise oriented GIS for Minnesota will also require a technical infrastructure that provides the data, tools, staff and knowledge to develop, implement and support the deployment of GIS technology across the enterprise.

Program Element #4: Data Services

The state requires a consolidated data management approach that will house and make available all of the state's "non-restricted" geospatial data assets. Right now, data are spread across many agency databases and there is significant redundancy of data storage across these agencies. In addition, there is no single source that enables a user to access all of the state's geospatial data. This resource will need to be carefully planned and designed and there are several options for deploying it that range from a centralized physical repository to a series of federated data servers that can act as a virtual data warehouse. Under all scenarios this resource will act as a ***data library*** whereby all geospatial information is indexed and directions and mechanisms for accessing the data are provided. This resource should be designed carefully with the full input of the major data custodial agencies.

Assuming that a data library can be constructed, it would need to provide a high level of service and availability and a variety of modes of data access, including:

- Providing **state agency** access
  - Direct, network-based data access
  - Data available for download
  - Consumable OGC web mapping services
- Providing **preferred partner** access (e.g. local govt., Fed govt.)
  - *Details TBD,* but possibilities include all forms of public access described below and the potential for secure, two-way data replication
- Providing **public access**
  - Data available for download
  - Consumable OGC web mapping services
  - Publicly available "data viewer(s)"
- Providing **data backup and disaster recovery**
  - Data contributed to the library will be backed up and data provided by third parties can be accessed or recovered in the event of problems at the local site

Critically, the "data library" must be ***actively managed*** with an identified entity providing "data custodial" services so that the library can be relied on to have the most accurate and current data available from a large variety of contributing agencies. Contributing agencies will include state government entities but also partner agencies in federal, county and local government agencies. In addition, the library should be managed to provide appropriate access to licensed commercial data sets.

Among the custodial services that the manager(s) of the library should provide is the identification and documentation of authoritative data sources (or lack thereof).

Similarly, the library should be managed so that all data contents are properly documented with metadata and so that the metadata is readily accessible. In essence, the library, with its associated documentation, serves as an authoritative data index and broker for any entity seeking information on the state's geospatial data assets.

Finally, given the fact that several state agencies that have data custodial responsibilities are able data managers, the management of the repository should include tools, and security protocols that enable these agency data contributors (e.g. DOT, DNR) to self manage when, and how their data are provided to the library. Data should not need to be provided to personnel that manage a "black box", rather, the data custodians should have a stake in managing the communal asset.

Program Element #5: Shared Web Services

As noted above (see section 0), in addition to managing the contents of the data library, the coordination entity needs to provide a variety of mechanisms for *accessing* the data. Increasingly, such mechanisms mean web services that can be consumed by web sites as well as desktop GIS software. In fact, Minnesota is already successfully deploying this approach for statewide orthoimagery, and it is highly likely that this activity will increase. Principally, there are two types of GIS services that are required:

A. Web Mapping Services. These services provide access to geospatial data, including the ability to standardize cartographic representation. Most likely, Minnesota would continue to use the Open GIS Consortium (OGC) standards for this function. In addition to Minnesota's successful publication of its orthoimagery as an OGC service, states such as Utah and Massachusetts make broad segments of their data holdings publicly available as consumable OGC services.

B. GIS Capability Services. These services provide access to discrete elements of GIS functionality. For example, some states (including Massachusetts[3]) have deployed common "geocoding services" that provide the capability to convert a "street address" into a coordinate pair (e.g. latitude/longitude). Over time, the State can deploy other high priority capability services (e.g. routing, point-in-polygon calculation, etc.).

In addition to standing-up and supporting a variety of web services, the coordination entity should actively inventory and index web services hosted by other entities, both within and outside of state government (e.g. county or university based web services). As with data, providing a brokering capability for finding, vetting and evaluating web services provides benefits to a broad array of state government GIS practitioners across numerous departments.

III. Training, Technical Guidance, and Project Support

The enterprise of state government has a broad array of GIS training and professional development requirements. The coordinating entity can help to both identify and meet training needs across state government. Options and activities may include:

[3] See http://lyceum.massgis.state.ma.us/wiki/doku.php?id=geocoding:home for details on Massachusetts's geocoding service.

Program Element #6: Training

A training program may include the development of in-house capacity and/or establishing training contracts with service providers (e.g. academic institutions, private sector) for **core GIS software training** requirements. An important element of this type of training would be helping to ensure that whoever provides the training customizes it to the state's GIS environment (e.g. the tools and data sets that the trainees will use on the job).

Program Element #7: Technical Guidance

Technical guidance activities may include:

- Development of **coaching and mentoring** programs whereby the GIS staff in more advanced agencies lend support to new users in agencies where GIS use is emerging.
- Development of **non-software training** programs/resources that are focused on **best practices**, common workflows and related technologies (e.g. GPS, image processing, etc.).
- Development of a **technical support hot-line** that is available to all state users. States such as New York have contracted to provide these services and have had substantial positive feedback from their user communities.

Program Element #8: Consulting and Project Support

Historically, state agencies have been able to acquire GIS consulting services from LMIC on a "fee-for-service" basis and this has been an important aid in new users getting started, or smaller organizations being able to supplement their in-house GIS capacity. This kind of project support and the availability of technical resources will continue to be needed. While this need is currently being met by an in-house technical team within LMIC and, to some extent, by staff at other agencies, the support and services are neither adequate nor coordinated. In addition, agencies that contract for their geospatial support face a cumbersome procurement process that hinders their ability to meet their needs on a timely basis. The coordinating entity can address these shortcomings by pursuing a strategic mix of options that include:

- Develop an enterprise team (with the size of the team TBD)
- Developing "master contracts", available to all agencies, with outside entities (e.g. the private sector) who can provide these services on an as-needed basis, and who can develop expertise with the state's data and infrastructure
- Providing facilitation services to help agencies identify appropriate entities to help them meet their project support and consulting needs (e.g. state agencies, academic institutions, private sector).