

ESTABLISHING A GEOSPATIAL INFORMATION OFFICE AT WHITE SANDS MISSILE RANGE

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Abstract

Establishing a geospatial information office within the garrison structure of White Sands Missile Range (WSMR) has proven to be a balancing act between technology advancements and work-flow process integration. The vision for the geospatial information office at WSMR is GIS access on each PC desktop within five years. The two biggest hurdles have been access to GIS services, both online and in traditional work orders, and the integration of GIS technology into day-to-day workflows. Access to the WSMR GIS databases, using ArcSDE and MS SQL Server 2000, has been configured to use a combination of Smart Card access, local SQL accounts, and secured web services. Process integration has been assisted by the adoption of a spatial data standard for facilities and infrastructure. This presentation will offer an outline of what decisions were made, how software was configured, what was learned from this process, and future goals and objectives.

Introduction

White Sands Missile Range (WSMR) has had access to GIS since 1998 when it was established through the ITAM program to support environmental work on WSMR. Several years later the Environment and Safety (ES) Directorate took over funding the GIS effort and within ES the GIS grew to support multiple range functions. This early GIS was separate from CAD operations at WSMR, but did rely on CAD and other

systems to develop the GIS databases. In 2002 WSMR recognized the need to move from a departmental GIS to an enterprise GIS and took steps towards establishing a Geospatial Information Office (GIO). The effort began in the Environmental Division of the Directorate of Public Works by staff geographer, Mr. Bryan Perdue. Mr. Perdue, with a small staff of contractors familiar with GIS and computer systems, established a file-based GIS system based on the Spatial Database Standard for Facilities, Infrastructure, and Environment (SDSFIE) data model created by the CADD/GIS Technology Center of the US Army Engineering Research and Development Center. In late 2004, the SDSFIE (version 2.4) data model was used to create an ArcSDE and SQL Server 2000 Enterprise GIS database. Migrating from a file-based system to ArcSDE/ArcIMS/ArcGIS Server and utilizing the SDSFIE v. 2.5 (2007) data model (modified to accommodate ArcGIS 9.2) has allowed the GIO to come a step closer to putting GIS on every desktop at WSMR.

Decisions Made

Office Formation and Location in the Organization

In the early stages of establishing the GIO, there were two competing issues that required resolution: 1) the GIO needed to be autonomous in order to provide the best service possible and 2) the GIO needed funding to provide the needed service. However, in the era of budget constraints and limited guidance from the Army, WSMR leadership created the position of GIO and established a hybrid office structure (Figure 1). The WSMR GIO is funded in part from the garrison executive office and the Directorate of Public Works. In addition, the GIO has a close working relationship with the PAIO

(Plans, Analysis, and Integration Office) in order to facilitate the integration of GIS technology into the day-to-day operations of WSMR.

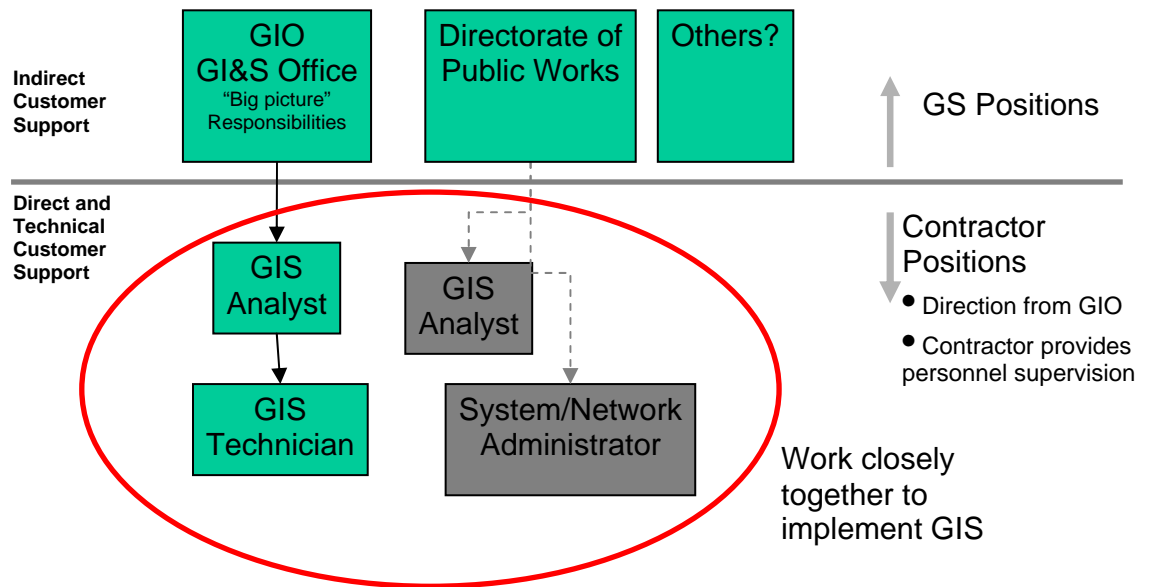


Figure 1. Hybrid office structure for the GI&S Office headed by the GIO.

Staffing

The GIO staffing follows the Federal Governments (or DoD) efficiency model of “Government own, contractor operated” of GOCO. The geospatial information officer, Mr. Perdue, is a government employee that currently supervises four contractors provided by the IT services contractor Caelum-Unitec. The contractor provides staff to the GIO in four functional areas that are defined by job title. The position titles are GIS Analyst, GIS Database Administration, GIS Technician, and GIS System Administration (Figure 1).

GIS User Community at WSMR

The GIS user community at WSMR is best described as users in a pyramid structure (Figure 2). The most experienced users, utilizing the full capabilities of ArcGIS

Desktop (ArcInfo license), are at the top. The next group of users utilizes ArcGIS Desktop at the ArcView level. This group has some GIS experience, but relies on the top group for advanced geospatial analysis. As use of GIS becomes more common place at WSMR, we foresee an expansion of the bottom two groups. For users that require an ArcView interface, but do not yet have the skills or the resources to acquire ArcView, we provide ArcReader documents. However, given the labor expense of supporting ArcReader (i.e. computer technicians needing to install or update the software), we see that largest group of future GIS users will be those that can access our GIS through a web browser. We currently use ArcIMS, but will be launching ArcGIS Server in the near future.

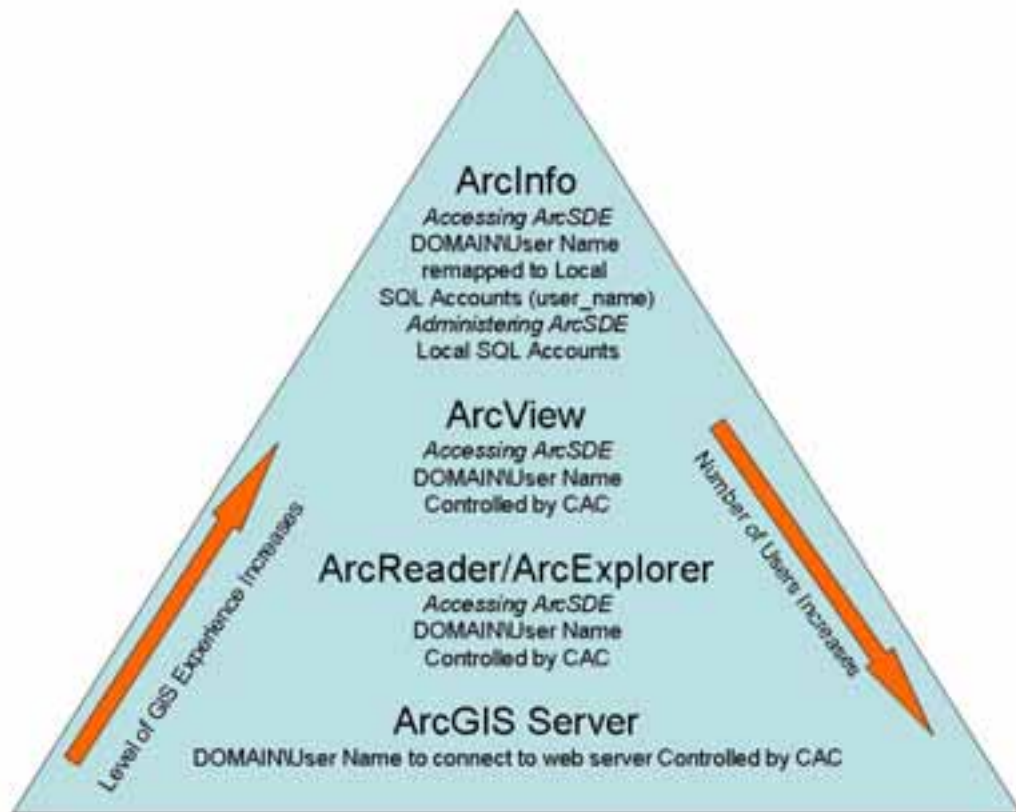


Figure 2. Conceptual model of GIS user community at WSMR.

Software Configuration

The initial file-based GIS databases consisted of a mixture of Arc/Info coverages, ArcView shape files, GeoTIFFs, and Mr. SID files. The files were organized based on the categories and sub-categories set by the SDSFIE standards (Table 1). This organization schema worked well until the office staff began to grow; at which time migration to a multi-user database became necessary.

Table 1. Feature datasets established by SDSFIE.

| | | | | |
|-----------|-----------------------|-----------------|---------------------|--------|
| Auditory | Communications | Future Projects | Landform | Visual |
| Boundary | Cultural | Geodetic | Military Operations | |
| Buildings | Demographics | Geology | Olfactory | |
| Cadastre | Ecology | Hydrography | Soil | |
| Climate | Environmental Hazards | Improvement | Transportation | |
| Common | Fauna | Land Status | Utilities | |

In late 2004 the SDSFIE database model was imported into SQL Server 2000, via ArcSDE version 9.0. The vector datasets were loaded into ArcSDE through ArcCatalog; however, the size of the raster datasets required a combination of using ArcCatalog from a PC client and using SQL Enterprise Manager to run a batch set of ArcSDE command-line statements to load and mosaic individual images. The original user model for the Enterprise GIS setup consisted of a small number of advanced GIS professionals accessing ArcSDE through ArcInfo Desktop, a larger group of experienced GIS users accessing through ArcView, and the rest of the user community connecting through ArcIMS. Under this model users would connect to ArcSDE using their User ID (DOMAIN\User Name) and ArcSDE was administered through local SQL Server 2000

accounts. Access to the SQL server was controlled by membership in Windows User Groups (Table 2).

Table 2. DOMAIN\User Name and local SQL user access model for WSMR.

| Windows Work Groups | Description |
|---------------------|---------------------------------------------------------------------------------------------------------------------|
| GIS_Admns | Experienced GIS users that administer the ArcSDE/SQL server and add and edit data. Access is through ArcGIS ArcInfo |
| GIS_Viewers | General ArcGIS ArcView users connecting to ArcSDE |
| GIS_External | Non-WSMR GIS users that need access to our GIS data |
| sde | ArcSDE administrator local SQL account |
| sdeadmin | ArcSDE data administrator local SQL account |
| arcgis | Generic local SQL account used to share ArcMap documents and allow users to connect with using DOMAIN/User Name |
| arcims | Local SQL account used by ArcIMS to connect to ArcSDE |
| Editor1 | Local SQL account used by editors to access and edit the ArcSDE geodatabase |

The migration in mid-2006 from DOMAIN\User Name pairs to Smart Card (Common Access Card or CAC) access prompted a change in the user model. The current configuration retains the ArcSDE administrative local accounts (Table 3) and adds SQL local accounts (user name), which are mapped from the login name (DOMAIN\User Name) to a SQL user name, for users that are editors (i.e. editor) of the data and viewers of the data (i.e. viewer). At this time, the above model will be used in our ArcGIS Server v9.2 Standard configuration. Access to the services provided by ArcGIS Server will be controlled via the Smart Card (CAC). A move to the ArcGIS Server Enterprise level is not being considered at this time. The additional functionality

that the top tier of ArcGIS Server provides is, in our opinion, more appropriate for the IMCOM GIO level.

Table 3. Modified user model for WSMR.

| Windows Work Groups or DOMAIN\User Name | SQL User Name | SQL Role | Description |
|-----------------------------------------|-----------------------|----------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| GIS_Viewers | firstname_lastname | Editors | Experienced GIS users that administer the ArcSDE/SQL server and add and edit data. Access is through ArcGIS ArcInfo. Authentication is through CAC |
| GIS_Viewers | arcgis gis_viewers | Viewers | General ArcGIS ArcView users connecting to ArcSDE. Authentication is through CAC and SQL password when using arcgis |
| GIS_External | gis_external | External | Non-WSMR GIS users that need access to our GIS data. Authentication is through CAC and SQL |
| SQL Local Accounts | sde | | ArcSDE administrator local SQL account. Authentication is through CAC and SQL password when using sde |
| | sdeadmin | | ArcSDE data administrator local SQL account. Authentication is through CAC and SQL password when using sdeadmin |
| | arcims | | Local SQL account used by ArcIMS to connect to ArcSDE. Authentication is through CAC |

Hardware Configuration

The initial file based GIS databases were hosted on a 2 processor server with 4 gigabytes of RAM. Research for an Enterprise class GIS pointed to designing a storage area network (SAN) solution. This gave us the capability to easily manage the diverse data stores and necessary GIS server applications. The enormous amounts of GIS data and its real time access, management and manipulation would significantly be hampered by transmission over the WSMR network backbone and it would also cause considerable bandwidth issues for the rest of the over 5000 WSMR users on the network. Adopting a SAN solution gave us the ability to perform most of the data manipulation and database maintenance and backup chores within the SAN itself without it impacting the WSMR network. Our research indicated that a state-of –the-art fibre channel SAN which gave us the System Scalability, Reliability, Initial Cost and Total Cost of Ownership which we needed.

The GIS SAN consists of five Intel based servers. Three servers provide the Microsoft SQL databases to store and manage the GIS information, administrative records and fire department databases. One Intel-based server provides applications, file and print services capability. One server provides network utilities, project management server and security updates services. The SAN storage space consists of 6 LUNS ranging from half a terabyte to 2 terabytes in size. The SAN consists of a smart SAN head and another configured for fail-over. We have 4 JBOD enclosures with a total of 64 fibre-channel drives. We have 2 SAN switches also configured for fail-over. We use a 56 slot tape library for backup and archive purposes. All internal SAN data transfers are fibre channel including backup.

GIS Data Flow

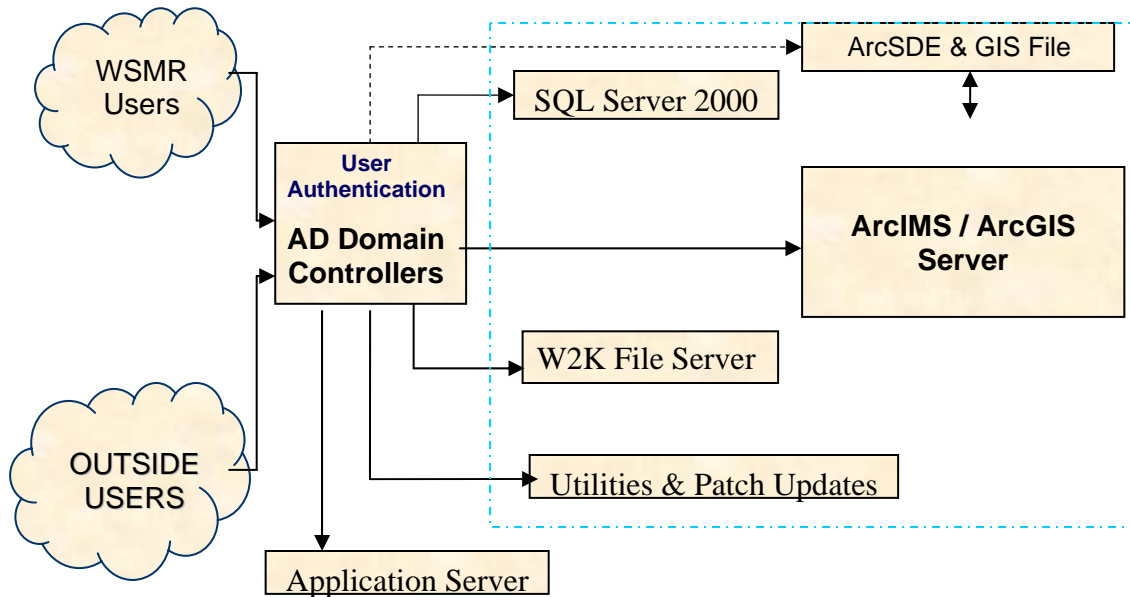


Figure 3. Conceptual Model of data flow for GIS users at WSMR.

Lessons Learned

One of the biggest lessons learned in the formation of the Geospatial Information & Services Office (GI&S) is that the GIO needs a plan of action and a vision...both of which resided with the staff geographer. The plan identified two critical areas for success – the need for upper management support and the need for dedicated funding - both funding and upper management support are critical to the success of an enterprise GIS. In this case, funding was reallocated from other programs to support the GIS effort due to upper management making a case for the value of the GIS. The placement of the GIO in the organization allows for a mixture of upper management support, a funding source, and a measure of autonomy. The support provided by management has allowed for the

recruitment and retention of GIS professionals that bring to bear the skills necessary for establishing an enterprise GIS. However, the GIO is not a stand-alone office within the Department of the Army.

The WSMR GIO has continued to work closely with the developers of the SDSFIE and has been an active participant in many policy action teams (PATs) associated with the IMCOM GIO. This close association has made it possible to be at the forefront with regards to enterprise GIS configuration and services provided.

Future Goals and Objectives

The two primary goals of the WSMR GIO are to establish a “Common Installation Picture” or CIP and to integrate some level GIS technology on every desktop at WSMR. The first goal – establishing the Common Installation Picture – has been accomplished. The second goal – integrating GIS technology on every desktop - will require a complete migration of current spatial and aspatial data into the enterprise GIS. An alternative is to integrate the Enterprise GIS with related databases, which will require the development of or the implementation of current QA/QC processes for the standard data layers needed for the CIP. The second goal also will require both an increase in the GIS professional staff and a closer working relationship with GIS professionals at the IMCOM GIO level. The additional GIS staff would include a relational database management specialist and a computer programmer with web-based GIS experience. Cooperation with the IMCOM GIO will allow for the development of ArcGIS Server tools that will give the subject matter experts access to their databases and to better serve the all GIS users at WSMR.

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References

SDSFIE, 2007, Spatial Data Standards for Facilities, Infrastructure, and Environment web site accessed on January 8, 2007; www.sdsfie.org.

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