

INFORMATION PAPER

NGB-ART/ARE
20 NOV 00

SUBJECT: Army National Guard Readiness Center Geographic Information Systems (GIS) Implementation Plan

1. **Purpose.** To provide a summary of the implementation plan for an ARNGRC GIS Program.

2. **Background.**

a. The ARNGRC GIS Implementation plan is incremental and follows the outline in Section 3 of Appendix I of this document. Access to the Map Server will be limited to Environmental (ARE), Training (ART), Installations (ARI) personnel through May 2001. The GIS Map Server data and software will be made available to all users in the ARNGRC in the final phase of the implementation (May – Aug 2001).

b. The GIS Map Server will consist of two servers connected to the ARNGRC local area network with a link to GuardNet. The GuardNet link will be used in the implementation to test the feasibility of serving GIS data and tools to the States, Territories, and installations. The test will include personnel from three to five States accessing the GIS Map Server over GuardNet.

c. The GIS Map Server will provide software and unclassified data for mapping, analysis, and queries. No software purchase is required for the beginning or low-level user to access GIS data and software tools at the ARNGRC. Intermediate-level users will also be able to freely use software on the GIS server, but will be limited to ten simultaneous users through FY01.

3. **Network Requirements.**

a. The use of the Map Server as a GIS tool in the ARNGRC will greatly reduce the potential impact of GIS on the network at the ARNGRC. The reduction in network load is accomplished by the use of map server software that sends geographic data to an end-user's web browser via a local web site. The network load required to operate the map server is equal to the network load required to load a standard web page (for example, the home page for GuardNet).

b. Low-level users will only access data through the Map Server web site. Intermediate to advanced GIS users will access data stored on their local computers or copied from the GIS server and will not be able to make direct connections to the data. Under this scenario, a T-1 line will not be required for GIS users in the ARNG.

c. The Map Server will have an end-user connection requirement within the accepted NGB-AIS guidelines. Intermediate to advanced level GIS users within the ARNGRC will access data that will be loaded on local hard drives using GIS software (as outlined in Appendix I section 2). Therefore, no network load is required for this software. There is no requirement for a T-1 connection under this scenario for end-users in the ARNGRC GIS Implementation Plan.

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APPENDIX I

1. Background.

a. The ARNG RC GIS plan will be implemented in phases. The first step to GIS implementation was the establishment of the required load and functionality of a server. The server specifications were determined by ARE. The server was purchased in order to serve geographic maps to a maximum of 100 ARNGRC simultaneous users; estimated to be two to three times the FY01 required load. The next step was the installation of the GIS server on the ARNG network, which took place 15 September 2000. Step three is the loading and testing of the GIS software. ARE and AIS are in the middle of the testing phase. The implementation is focused on use within the ARNGRC.

b. The feasibility to serve GIS data to the 54 States and Territories will be evaluated during the first 6 months of implementation within the ARNGRC. The ArcIMS (Arc Internet Map Server) software will be utilized by a maximum of 10 users outside the ARNGRC in order to test the feasibility of serving GIS to the 54 states and territories from the ARNGRC. This will be limited to ArcIMS and will not include serving data to the states for use with ArcView or ArcInfo.

c. Two Servers are required for the GIS Implementation. ARE has already purchased a Dell Server and a Compaq Server. The Dell server is a Poweredge 4400 with dual 866 MHz Pentium III Xeon processors, 1 GB of RAM, and 27 GB of memory on 2 drives using SCSI Ultra3. The Compaq server is a Proliant DL380 with dual 733 MHz Pentium III processors, 4 GB of RAM, and ten 18.2 GB SCSI hard drives mounted in a media bay with a RAID (Redundant Array of Independent Disks) controller. The server is running Microsoft Internet Information Server (IIS) 4.0, Servlet Exec 3.0, Java JRE 1.2.2-006, and ArcIMS 3.0. Periodic backup of the system files, software, and data on the servers will be performed by AIS, at an appropriate time interval. The preferred method for backup is high capacity tape.

d. The servers will be phased in during the initial stages of the implementation in the late fall and early winter of 2000. Initially, the Compaq Server will house the spatial data and ArcIMS map server, and function as an application server for ArcView. The Dell Server will later be the primary ArcIMS map server and the Compaq server will function as a spatial data and application server for 10 floating ArcView licenses. A redundant map server will be set up on the Compaq Server. Use of automated re-routing to the redundant map server in case of server or software failure will be investigated.

e. A router will be installed to provide a segmented connection between the Compaq and Dell servers. This router will speed up data queries, while simultaneously helping to minimize the load on the network in the ARNGRC.

f. The GIS data server will provide data for mapping, analysis and queries via the network in the ARNGRC. An unclassified ARNG data set will reside on the data server for use by all users within the ARNGRC. Data will come from various sources; ARE's CD library, installation data libraries, USGS, , NIMA, DoD, ARI Master Planning, ART Range Development Plans,

Integrated Training Area Management Programs, etc. Data structure and content standards for the server, which include aspects of the Spatial Data Standards (SDS) for facilities, infrastructure, and environment will be established. After the data structure is finalized, a QA/QC (Quality Assurance/Quality Control) methodology will be established in order to move spatial data from various sources into the database, and all data will be validated before it is published to the network. Attribute data will be accessed over the ARNGRC network from existing databases such as PRIDE, ECAS, EPR, EQR, IRS, IWAM, as well as from division specific databases.

g. This implementation plan can be altered when required to meet NGB-AIS standards or network capacities.

2. Software Packages.

a. There are several software packages that we will be utilized in the implementation of GIS to the ARNGRC. ESRI (Environmental Systems Research Institute) makes the GIS software that ARE and ART (and 90% of the GIS community) utilizes. The following ESRI GIS software packages will be part of the implementation: ArcExplorer, ArcView, ArcInfo, ArcIMS, and ArcSDE (Arc Spatial Data Engine). Additionally, Microsoft Structured Query Language (SQL), and RTS Networks Spatial Meta-data Management System (SMMS) will be implemented.

b. ArcIMS is an Internet mapping application that provides GIS functionality to the entry-level user in the ARNGRC. It will enable them to view and print maps, and run simple queries on data. It is the best available software solution for providing GIS capability to clients and minimizing system load.

1) ArcIMS offers two web clients – a Java client and an html client. The Java client requires the installation of the Java JRE 1.2.2-005 or higher and installs a Java web viewer on the client's browser prior to loading an ArcIMS Java map page for the first time. The html interface has a lower overhead requirement, but the Java interface has the advantage of increased functionality. The html client opens in Microsoft Internet Explorer 4.0 or later version. The Java client may require IE 5.0.

2) ArcIMS acts as a GIS data broadcast tower (picture a radio tower) to ArcExplorer 3, and in the near future, to ArcInfo 8.1 and ArcView 8.1. This presentation of GIS data is called a MapService under ArcIMS. The network requirements of ArcIMS acting as a MapService data source to ArcInfo 8.1 and ArcView 8.1 will be evaluated when the products are released in 2001. Upon the release of version 8.1, ArcInfo data connections (which will only be available in the ARNGRC) will be limited to the low bandwidth use of ArcIMS MapServices, rather than connections directly to the data over the network.

c. The two current versions of ESRI's free GIS software, ArcExplorer, were released simultaneously in 2000. ArcExplorer 2 is the latest Windows version of ESRI's, easy-to-use, GIS data viewer. It can be used to display and query locally stored GIS data. It has an interface to the Internet that allows GIS Data to be downloaded for use on a hard disk drive local to the client. ArcExplorer 3 is a complete, easy-to-use GIS data viewer that displays and queries

locally stored GIS data as well as MapServices from ArcIMS 3. ArcExplorer 3 is built with Java, which allows cross-platform support. ArcExplorer 3 is more closely integrated with ArcIMS and is therefore the preferred version for use in ARNGRC.

d. The current version of ArcView is version 3.2. ArcView is a desktop GIS data creation, editing, and analysis software that is designed for intermediate level GIS users. It is currently loaded as a standalone application on at least 6 machines in the ARNGRC. ArcView has been deployed in at least 30 States and Territories since its release in the early 1990's, and 2 ArcView licenses have been shipped to the 54 States and Territories in 2000 by ARE and ART. Basic ArcView training is available to ARNG personnel, and in 2001 all ARE-C personnel will be taking ESRI certified ArcView training. ARE has made 10 network licenses of ArcView available to all users in ARNGRC. The ten floating ArcView licenses will reside on the Compaq server at ARNGRC. The end-user will perform a network installation of ArcView to install the program on the client PC. After installation, the only load on the server from running ArcView will be an initial download of the program executables to the client during the beginning of each session. GIS commands will be run on data that is stored on local clients, not from data served on the Compaq server.

e. The current version of ArcInfo is 8.02. It is a GIS package that is designed for advanced GIS users. ArcInfo is currently loaded as a standalone application on one machine in the ARNGRC, and will be operated on at least 3 machines at the ARNGRC by mid FY01. It has been utilized in at least 12 states since its release in the mid-eighties, and ARE is planning to field ArcInfo to all 54 States and Territories in 2001. The network load of ArcInfo in the ARNGRC will be minimized by not utilizing direct connections to the GIS data server until the release of version 8.1 which will allow low-bandwidth connections to ArcIMS MapServices.

f. ESRI is in the middle of implementing a new architecture for GIS data with ArcInfo 8.02 and ArcView 8.1 (not yet released). The data format is moving to an object oriented data model. This will enable GIS data to be stored in a Relational Database Management System (RDBMS) as an object. The benefit to this is that instead of storing most of the functionality in the application, it will be stored in the data (read: smart data). RDBMS technology can be utilized in conjunction with the spatial data in order to store rules and behaviors. This means that a wetland polygon will behave like a wetland polygon; for example, it may be programmed to not allow a road to be built through it without entering a permit number from the army Corp of engineers. RDBMS also provides the capability to do network routing (road networks, water networks, electric networks and fiber optic networks).

g. ESRI's ArcSDE is middleware that allows for spatial data to be stored directly in the RDBMS of your choice. ARE will utilize SQL Server as the RDBMS. ArcSDE reduces network load by as much as 50% by allowing the querying of spatial data to occur within the RDBMS on the data server, rather than on the client. When SDE is not being utilized to render a map or run a query, the GIS application pulls the entire dataset across the network. With SDE running, the GIS application sends the current map extent to the RDBMS and the RDBMS queries and sends only the parts of the data that are needed to render the map. This drastically reduces the demands on the network and greatly increases the rendering and querying speed of the application.

h. The Spatial Meta-data Management System (SMMS) makes it easy for anyone, regardless of prior knowledge of the Federal Geographic Data Committee (FGDC) standard, to create, manage and publish FGDC-compliant metadata. Creating FGDC-compliant meta-data is essential in order to meet the requirements laid out in Executive Order 12906, “Coordinating Geographic Data Acquisition and Access: The National Spatial Data Infrastructure.”

3. Implementation Phases.

a. Initial Implementation Phase (Oct – Dec 2000)

1. Testing of ArcIMS (Oct – Dec 2000)
2. Set up spatial data structure on Compaq Server (Oct – Dec 2000)
3. Establish QA/QC methods for data moving to Compaq Server (Oct – Dec 2000)
4. Migrate spatial data onto Compaq Server from CD archive (Oct – Dec 2000)
5. Setup Dell Server (Nov – Dec 2000)
6. Buy router (Nov 2000)

b. Intermediate Implementation Phase (December – May 2001)

1. Continue migration of spatial data onto Compaq Server (Dec – Feb 2001)
2. Connect Dell Server to Compaq (Nov – Dec 2000)
3. Move ArcIMS onto Dell Server and Install ArcSDE (Dec – Jan 2001)
4. Create ArcIMS MapServices and web sites (Dec – Mar 2001)
5. Install SQL Server on Compaq Server (Jan – May 2001)
6. Connect GIS Services to Storage Area Network (SAN) (Apr – May 2001)

c. Final Implementation Phase (May – Aug 2001)

1. Create Geodatabase (Jun – Aug 2001)
2. Customize ArcIMS interface (May – Aug 2001)

d. Ongoing

1. Data QA/QC as new data becomes available
2. Creation of new MapServices for new data

3. Data management
4. MapService and web site maintenance

4. Number of Users.

a. During the initial implementation phase, ArcIMS usage will be limited to ARE, ART and ARI. The maximum number of simultaneous users that are anticipated during this period is five. Use will be limited to the ARNGRC and a maximum of five states through GuardNet. The connection to the states will be utilized to test response time and the feasibility of the ArcIMS software to serve maps to the States and Territories from the ARNGRC.

b. During the intermediate implementation phase, ArcIMS will be available to all users in ARE, ART, and ARI.

c. During the final implementation phase, ArcIMS will be available to all users in the ARNGRC and five States via GuardNet. The servers will be evaluated for load and required server upgrades.

d. Early in the Implementation, ArcView will be available to ARNGRC personnel for up to 10 simultaneous users via the Compaq Server. These users will be restricted to accessing data on their hard drives until the final implementation phase.

e. ArcExplorer will be utilized by no more than 25 users in the final implementation phase. These users will be connecting to the ArcIMS MapServices on the GIS server in order to author maps.

f. ARE/ART will investigate the network requirements of utilizing the Compaq server as a data server for ArcView, ArcInfo, and ArcExplorer within the ARNGRC.

5. Potential benefits.

a. Adding GIS capabilities for ARNGRC personnel will further the goal of integrating databases between ARE, ART, ARI, ARL, and others. The importance of integrating databases across divisions is an issue that is receiving increasing attention at ARNG. In Nov 2000 there was a 2-day Training Center Advisory Council (TCAC) workshop that focused on this topic. GIS is the primary tool that will allow ARNG to achieve database integration.

b. The Department of the Army's \$22 million Active and Inactive Range Inventory (Oct 00 – Mar 02) will produce large quantities of geographic data that will require validation. Only those who have GIS capabilities will be able to use the data from the inventory. In addition, various other NGB contracts are creating GIS data, for example; Range Development Plans, and Integrated Natural and Cultural Resource Management Plans.

c. Implementation of RDBMS also provides the capability to do network routing, and would allow for the GuardNet infrastructure to be mapped using GIS. If a situation arises where specific states have network inter-connectivity outages, GIS could be utilized to trace the network back and find all the routers that could cause this problem, thereby saving critical time in determining which router to fix.

d. By having ready access to GIS software, ARNGRC personnel will be able to present complex data in easy to understand geographic maps and tables. The increased access to GIS tools will result in greater use of GIS maps and other products at ARNG, and will improve the quality of reports and briefings.