Geography

1.0 Geography Division Overview

Although the Geography Division is part of the Decennial program area, we discuss it separately in our Plan as a special interest item. This section describes two major components: the Geographic Support System (GSS), our IT support for most of the U.S. Census Bureau's censuses and surveys; and the GSS Infrastructure, which comprises our Division's infrastructure.

The Geographic Support System is an integrated and automated computer-based system used to establish and maintain accurate geographic boundaries within the Topologically Integrated Geographic Encoding and Referencing (TIGER) System and accurate addresses in the Master Address File.

The GSS Infrastructure includes IT resources that are not program specific but are part of the support structure for the day-to-day activities of our employees. This includes our office automation and Local Area Network support.

The goal of the Geography Division is to provide the basic maps, reference files, and associated processing systems needed to meet the geographic requirements of all U.S. Census Bureau programs. It has five basic components:

Building and maintaining the TIGER database and the Master Address File of housing units and economic establishments: the Master Address File is crucial to conducting many U.S. Census Bureau programs, including the 2000 Decennial Census and the American Community Survey. Continuously updating the Master Address File is the most cost-effective and quality-assured method for providing a housing unit address list.

Continuing to link the Master Address File with the TIGER database: this crucial on-going effort involves linking the Master Address File to the TIGER database, which produces maps and the names of all governmental units for data tabulations. TIGER also allows us to assign every housing unit and business establishment address to the correct census block for processing and tabulation. Linking the Master Address File to the TIGER database is the most efficient and cost effective way of adding new streets and housing units and their locations and ZIP codes to U.S. Census Bureau databases.

Continuing our partnerships with state, local, and tribal agencies: we are continuing to support partnerships with state, local, and tribal agencies. To address past concerns expressed by officials at all levels of government and to increase the confidence of our customers with census results, we provide opportunities for local officials to review existing information about streets, boundaries, and addresses. We listen to suggestions from those officials

about corrections they believe are necessary, and provide feedback to those officials to document our actions on each suggested correction. This includes an opportunity to review the updated maps and address listings after processing the corrections.

Maintaining the quality of our Geographic Support products: we employ statistically sound techniques to the quality evaluations that build, update, or enhance the TIGER database and the Master Address File. Quality evaluation and correction is an integral part of our operations, ensuring that any sub-standard work is identified at the earliest possible stages.

Acquiring TIGER and Master Address File hardware: acquiring replacement hardware to process the TIGER database is critical to the success of all Geographic Support efforts. The hardware will help produce maps needed to implement our cooperative programs, update the TIGER and Master Address File databases, and provide acceptable products for new partners in our cooperative programs.

The Geography program area supports Decennial Census activities and provides accurate geographic information and lists of spatially located addresses. These are essential for the U.S. Census Bureau to provide accurate statistical data for:

- **apportioning Congressional seats among the states;**
- **redistricting Congressional and state legislative representation and governmental or administrative subdivision;**
- **distributing federal and state funds for formula grant programs; and**
- **analyzing economic and demographic data by private, academic, and government sectors.**

The Geography Division plans, coordinates, and administers all geographic and cartographic activities needed for the U.S. Census Bureau's nationwide statistical programs; Geography also manages the U.S. Census Bureau's continuous updates of features, boundaries and geographic entities.

The Geography Division works with state, local, and tribal governments in helping to maintain national spatial data. The Geography Division supports the efforts of the Federal Geographic Data Committee under Executive Order 12906. The U.S. Census Bureau uses addresses and related information from the U. S. Postal Service in exchange for geographic and spatial information (Public Law 103-430).

1.1 Geography Division Products, Services, and Customers

The Geography Division provides the following major products and services to these customers:

Products/Services	Customers
paper maps* digital maps* TIGER/Line TIGER/Census Tract Street Index files TIGER/Census Tract Comparability files	all data users and U.S. Census Bureau program areas
TIGER database Master Address File	U.S. Census Bureau program areas only

***These products are also provided to the U.S Census Bureau's private sector partners who help keep the spatial database up-to-date. Samples of these products are available on the Internet at www.census.gov/geo/www/index.html.**

Our customers often repackage our data and offer them on CD-ROM, the Internet, or other media. These customers depend on us to continuously maintain our Geographic Support System. A large number of firms (you can find a list of these vendors at www.census.gov/geo/www/tiger/vendors/html) use various U.S. Census Bureau extract data/programs for the following purposes:

- **address matching;**
- **geocoding;**
- **mapping;**
- **redistricting services;**
- **vehicle routing and dispatching;**
- **desktop mapping;**
- **land survey;**
- **site location;**
- **marketing analysis and studies; and**
- **transportation management.**

Examples of public and private sector applications that use TIGER extract products include:

- **the New York City Metropolitan Transportation Authority, for devising more efficient routes for carpooling, snow-clearing, meter-reading, and garbage-collecting in their 32 counties;**
- **the Newport News, Virginia, waterworks, to extract products and its own water line database to create a geographic information system that includes a 250 square mile territory;**
- **the Baltimore County, Maryland, Police Department, to geocode spousal abuse cases and link them with variables such as income and employment;**
- **the Maryland Department of State Planning, to produce customized files for each of Maryland's 23 counties and the City of Baltimore;**
- **local planners, to determine where services are needed for the elderly, child care facilities, recreation sites, schools, and libraries;**
- **ALK Associates of Princeton, New Jersey, to produce software used for routing;**
- **Caliper Corporation of Newton, Massachusetts, to produce several types of Geographic Information System software; and**
- **Chicago Itap Corporation of Lemont, Illinois, to produce a desktop street-mapping package.**

1.2 Geography Division IT Objectives

The Geography program area's IT objectives are:

- **providing geographic data and supporting customers inside and outside of the U.S. Census Bureau;**
- **exploring new technologies in digital cartography and Geographic Information Systems;**
- **reducing software development costs by using commercial off-the-shelf software when possible; and**
- **continuing our cooperative programs with the other federal agencies under the Federal Geographic Data Committee, and with state, local, and tribal governments.**

2.0 Geography Division IT Support

The table below presents our major geographic IT support systems. Several of these, such as the TIGER database and the Master Address File, support the Decennial Census and the American Community Survey; direct relations to Decennial Census activities are indicated in the second column. The Geography Division also supports (in terms of continuous operations) the Regional Offices and other censuses (e.g., Economic); these continuing operations are indicated in the third column. A detailed description of each follows the table. In addition to the direct Geographic Support System (GSS) program, GSS also helps provide specialized products and services for the Decennial Census. Please see the Decennial program area section of this Operational IT Plan for the documentation of the development and production of these decennial-specific products and services.

Geography Program Area IT Support	Decennial Related	Continuing Operations
Geographic Support Programs		
Geographic Update System (GUS)	✓	✓
Map Production System	✓	✓
Intranet Geography Web System	✓	✓
Enterprise Support	✓	✓
TIGER	✓	✓
Research Programs	✓	✓
Master Address File (MAF)	✓	✓
Local Update of Census Addresses (LUCA)	✓	
Boundary and Annexation Survey (BAS)	✓	✓
Decennial Support Programs		
Census 2000 Redistricting Data Program	✓	
Participant Statistical Areas Programs	✓	
Urbanized Area Delineation	✓	

In addition to the programs listed, the Geography Division is proposing a 21st Century Master Address File/TIGER new initiative. This initiative will allow the U.S. Census Bureau to further develop the capabilities of the Master Address File/TIGER system. This initiative also allows the sponsoring and participating organizations to begin activities that will further develop the Master Address File/TIGER system by using new technology, commercial off-the-shelf software, and new address and geographic data sources. The IT-related costs for this initiative are reflected in the Census Modernization initiative.

Supporting a "Digital" Department of Commerce

The following are just a few examples of how the Geography Division uses "digital" technology to support the Decennial Census and other U.S. Census Bureau activities:

Intranet Geography Web System: this is the primary means of providing information to Regional Offices and other clients within the U.S. Census Bureau.

Map Production System: map production is done at the Regional Census Centers, the National Processing Center, and Headquarters. The maps (in digital form as a Map Image Metafile) are then transmitted to the actual map plotting sites. Software then converts the Map Image Metafiles to output device-specific format (Hewlitt-Packard Graphical Language or PostScript) and sends the resulting print file to the output device. Thus, map production is a two-step process. First, on a computer system where a Master Address File and TIGER database is located, a Map Image Metafile is created (the Map Image Metafile may contain more than one map sheet). The Map Image Metafile may then be processed for printing immediately, copied by network to another computer system for printing later, or copied to CD-Recordable for shipment to a remote printing site (for example, Local Census Offices).

The Master Address File is a database of all addresses in the United States; the residential addresses in this database will be validated prior to Census 2000 mailing and enumeration activities. It is an essential component of every census operation in which housing unit addresses are used. For example, addresses in the Master Address File are critical to the production of maps. Thus, the Master Address File can be thought of an address database with geographic components that complements the TIGER database, a geographic database with address components. Programs and projects that rely on detailed address information use the Master Address File.

Topologically Integrated Geographic Encoding and Referencing (TIGER®) System: the TIGER® database provides geographic products such as maps and the spatial characteristics of all governmental units for data tabulations. It also allows us to automatically and electronically assign every residential and business establishment address to the correct spatial location for processing and tabulation.

2.1 Geography Division IT System Descriptions

2.1.1 Geographic Support System

To support its various censuses and sample surveys, the U.S. Census Bureau has developed an integrated and automated computer-based Geographic Support System (GSS). The GSS requires large volumes of information from many external sources to establish and maintain accurate geographic boundaries within the TIGER database and accurate addresses in the Master Address File. This information must be updated on a regular basis to validate all of the boundaries and addresses contained in the GSS. GSS provides a geographic framework from which the U.S. Census Bureau can generate the maps for:

- **collecting and validating boundaries (government and physical);**
- **compiling and validating address lists;**
- **collecting field data; and**
- **disseminating data products.**

GSS also provides a geographic basis for:

- **assigning the housing units, farms, and business establishments in each census and sample survey to a specific geographic location;**
- **automating questionnaire check-in and control systems to generate follow-up assignments or reminder notices; and**
- **developing a source file from which the U.S. Census Bureau can generate geographic table stubs and summary cartographic products for data tabulation and customer support purposes.**

Subsystems within the GSS are:

Geographic Update System

The Geographic Update System can reference a portion (such as a single county) of the TIGER database and the Master Address File for updates and corrections to these databases, or for research purposes. It is also used in various areas of the U.S. Census Bureau for reviewing counts, resolving problems, and analyzing data.

Map Production System

Map production is done at the Regional Census Centers, the National Processing Center, and Headquarters. The maps (in digital form as a Map Image Metafile) are then transmitted to the actual map plotting sites. Software then converts the Map Image Metafiles to output device-specific format (Hewlitt-Packard Graphical Language or PostScript) and sends the resulting print file to the output device. Thus, map production is a two-step process. First, on a computer system where a Master Address File and TIGER database is located, a Map Image Metafile is created (the Map Image Metafile may contain more than one map sheet). The Map Image Metafile may then be processed for printing immediately, copied by network to another computer system for printing later, or copied to CD-Recordable for shipment to a remote printing site (for example, Local Census Offices). The following are typical map production methods:

- **maps are produced at Regional Census Centers/the National Processing Center and are distributed locally;**
- **maps are produced at Regional Census Centers and sent to Local Census Offices for distribution;**
- **Map Image Metafiles are transferred onto CD-ROMs and fowarded to Local Census Offices for production and distribution.**

For more specialized maps required for reports, and after "one-time" products, the U.S. Census Bureau does basic interactive map editing and map image manipulation using its graphic workstations and file servers as the host for the map files. This system uses Map Image Metafiles or the TIGER/Line files. During this process, we use both commercial and customized software for the graphic workstations and file servers.

Intranet Geography Web System

The Intranet Geography Web System is the primary means of providing information to Regional Offices and other clients within the U.S. Census Bureau. Available information includes:

- **GSS Help System (program and clerical reference manuals);**
- **problem referrals;**
- **Geographic Update System documentation;**
- **TIGER documentation;**
- **production status reports; and**
- **Geographic IT configuration, support, and documentation.**

Enterprise Support

The Geographic Update System, the Map Production System, and the Geography Intranet Web System are managed and supported within the Geography Division. The sole exception is the OpenVMS Alpha cluster of servers located in the Bowie Computer Center. All of the large-scale UNIX servers and UNIX workstations in the Regional Census Centers, the National Processing Center, and Headquarters are part of the enterprise support performed under the Geographic Support System.

Topologically Integrated Geographic Encoding and Referencing (TIGER) System

TIGER supports all Demographic and Economic current surveys, the Economic Censuses, various research and development projects, the Decennial Census pretests, various Census 2000 operations, and the American Community Survey.

The TIGER database is divided into 3,287 county partition files, with some counties further subdivided into multiple partitions to improve processing efficiency. Updates and corrections to the TIGER database and Master Address File take place in the Regional Census Centers, the National Processing Center, and at Headquarters, using graphic workstations and PCs connected to file servers at their location. Database partitions are checked out from the master database at the Bowie Computer Center for update operations.

Corrections and additions to the TIGER database are made by clerks using annotated paper copies of census maps or by computer-assisted transfer of new feature information from locally provided spatial files.

As part of keeping TIGER up-to-date, the U.S. Census Bureau has partnerships with local governments. Local governments and regional and metropolitan agencies assist us in locating and updating missing or incorrect street features, street names, and address ranges. This information is used to link the Master Address File to the TIGER database.

The TIGER Control System controls the movement of the TIGER and Master Address File files between processing sites (Regional Census Centers, Headquarters, the National Processing Center, etc.), tracks their locations, tracks processing activities, and ensures database integrity. The decentralized approach to updating and validating the TIGER database (by providing the relevant file locally to the Regional Census Centers for processing) must be coordinated with other outside updates and validations so that database integrity is preserved. This system uses considerable computer resources for integrity edits as well as significant telecommunications bandwidth.

Figure 1, shown on the following page, illustrates the Geographic Support System update process for partnership programs.

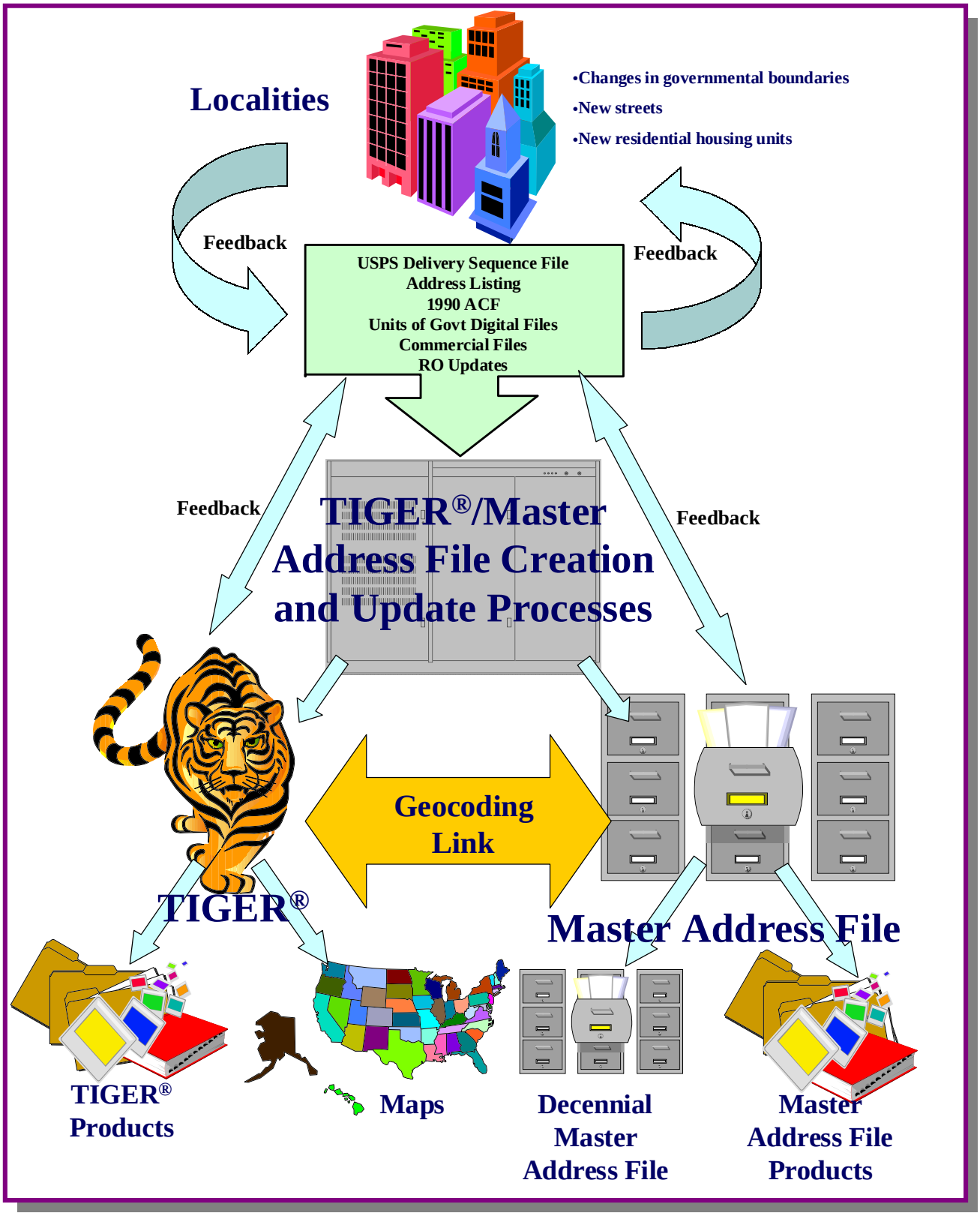

Figure 1: Basic Interactive Data Flow Associated with the Geographic Support System and Updating TIGER and the Master Address File

Research Programs

TIGER has several shortcomings; one of these is its lack of positional accuracy. The U.S. Census Bureau has looked into various projects to improve the co-ordinate quality of the TIGER database: two of these projects currently being investigated are the use of the Global Positioning System and the use of digital imagery by the Geography Division's Geospatial Research and Standards Staff.

The Global Positioning System is a satellite-based navigation and real-time transfer system; by using its receiver, a user is able to identify their exact location and elevation anywhere on Earth. Because this system is highly accurate and reliable system, the Geospatial Research and Standards Staff is considering using this technology to improve the TIGER database. This would be achieved by using the Global Positioning System to accurately locate various roads, housing units, etc. that exist both in the real world and in TIGER . Similarly, the coordinates of roads and other features will be captured from digital images of the same areas. Once these data are gathered, they would be used to correct errors in TIGER . Ultimately, this could produce a TIGER database that will not only be current, but will also be highly accurate.

Master Address File

The Master Address File is a database of all addresses in the United States; the residential addresses in this database will be validated prior to Census 2000 mailing and enumeration activities. It is an essential component of every census operation in which housing unit addresses are used. For example, addresses in the Master Address File are critical to the production of maps. Thus, the Master Address File can be thought of an address database with geographic components that complements the TIGER database, a geographic database with address components. Programs and projects that rely on detailed address information use the Master Address File.

Local Update of Census Addresses (LUCA)

LUCA offers local governments the opportunity to review and update the list of individual residential addresses used for Census 2000. This list is based on the addresses in the Master Address File. Public Law 103-430 calls for this review to be conducted by locally designated census liaisons who must agree to maintain the confidentiality of the information on the census address list. The U.S Census Bureau Regional Offices will maintain contact with the liaisons and provide feedback on the making of submitted corrections in accordance with Public Law 103-430.

Boundary and Annexation Survey

The U.S. Census Bureau normally conducts a Boundary and Annexation Survey (BAS) each year to maintain the inventory of general purpose governments and to update information about the boundaries of larger population entities. In years ending in 1,3,4,5, and 6, we limit the BAS to incorporated places with a population of 5000+. In years ending in 2 and 7, we include in

the Boundary and Annexation Survey incorporated places with a population of 2500+. In years ending in 8,9, and 0, the Decennial Census helps us expand the Boundary and Annexation Survey to include all legal entities, regardless of size.

The table opposite summarizes the different entities included in the Boundary and Annexation Survey:

Years	All Sizes	Entities 2500+	Entities 5000+
ending in 1,3,4,5,6			✓
ending in 2, 7		✓	✓
ending in 8,9,0	✓	✓	✓

Decennial Support Programs

Census 2000 Redistricting Data Program

This program encompasses the various activities that create the geographic context for tabulating Census 2000 data used by the states in their redistricting activities under Public Law 94-171. During the Block Boundary Suggestion Project, the U.S. Census Bureau offers state redistricting officials the opportunity to incorporate features they request be held as Census 2000 block boundaries.

During the Voting District Project, the state redistricting officials will submit the boundaries of voting districts (precincts) and state legislative districts that follow many of the features they provided during the Block Boundary Suggestion Project.

Participant Statistical Areas Programs

These programs enable local participants to delineate, following U.S. Census Bureau guidelines, statistical areas such as census tracts, block groups, census designated places, and census county divisions.

These statistical areas are the basis for the tabulation of Census 2000 data and are used extensively by both the public and private sectors.

Urbanized Area Delineation

The U.S. Census Bureau delineates urbanized areas to provide a better separation of urban and rural territory, population, and housing in the vicinity of larger places.

The 1990 definition of an urbanized area is an area consisting of a central place(s) and adjacent urban fringe that together have a minimum residential population of at least 50,000 people and generally an overall population density of at least 1,000 people per square mile of land area. The U.S. Census Bureau uses published criteria to determine the qualifications and boundaries of urbanized areas.

The 2000 urbanized area definition (criteria) is in progress and will be completed in fall of 1999.

Components of the Geographic Support System are located in the following areas.

Bowie Computer Center: the master TIGER database and the Master Address File reside on a single Open VMS Alpha cluster currently consisting of two systems.

Regional Offices/Regional Census Centers: users update and access the TIGER and Master Address Files databases and are able to print maps and address lists. At the time the Regional Census Centers were opened, the geographic IT equipment was transferred from the Regional Offices to the Regional Census Centers. The equipment will be returned after the Regional Census Centers are closed. Each Regional Census Center/Regional Office has UNIX file servers, graphic workstations, PCs, and printers.

Suitland Beta Site: the replica of the complete Regional Census Center configuration includes geographic operations for testing the configuration software distribution to the Regional Census Centers.

National Processing Center: same as our Regional Offices. The emphasis is on continuing census operations.

Headquarters: Headquarters performs all software development work; major system administration for itself, the Regional Census Centers, and the National Processing Center; and coordination with other federal agencies. Headquarters also has users that update and access the TIGER and Master Address File databases and are able to print maps and address lists. The emphasis is on special purpose and management operations. Headquarters also has a replica of the Regional Census Center geographic configuration for preliminary software testing.

Dedicated data communication links are used for file transfers and sending control/status information between the Bowie Computer Center, the Geography Division, the National Processing Center, the Regional Census Centers, and the Regional Offices. Local Area Networks connect graphic workstations and PCs at each site.

U.S. Census Bureau employees in all the Regional Offices update and correct the TIGER database and the Master Address File by using graphic workstations and PCs connected to UNIX file servers. Those UNIX file servers are linked via the U.S. Census Bureau's Wide Area Network to the main file server/processing environment in the Bowie Computer Center.

Corrections and additions to the TIGER database are made by clerks using annotated paper copies of census maps or by computer-assisted transfer of new feature information from locally provided spatial files.

The map production system creates maps at all Regional Census Centers, Regional Offices, and the National Processing Center. Map Image Metafiles, a digital construct of a map, are produced on file servers and then converted to Hewlett-Packard Graphical Language or Adobe PostScript, then transmitted, depending on map type, to small- or large- format printers.

The computer clusters that the Geographic Support System uses are given in the following table:

Description	Location
Geo Bowie Computer Center Production Cluster	Bowie Computer Center
Geo HQ Development Cluster	HQ; Geo Division
Geo Distributive Production Cluster	HQ; National Processing Center; Regional Census Centers
Research Server	HQ; Geo Division

Each cluster has the following configuration:

Geography Bowie Computer Center Production Cluster

- multiple Compaq Computer (formerly Digital Equipment) Corporation computers grouped into an Open VMS Alpha cluster multi-processor environment with at least 2,000 GB of disk storage and 4 GB of memory; and

- Silicon Graphics UNIX file server with 16B of memory and 140 GB of disk storage for remote backup of geographic and decennial support data.

Geography Headquarters Development Cluster

- multiple UNIX multi-processor file servers with at least 200 GB disk storage for general software development. Associated with these servers are PCs and Silicon Graphics (SGI) graphic workstations;

- Compaq Computer (formerly Digital Equipment Corporation) Compaq Tru64 UNIX machine for software development;

- multiple Silicon Graphics UNIX multi-processor file servers with at least 200 GB disk storage (identical to the Regional Census Center configuration) for testing Regional Census Center applications;

- multiple Silicon Graphics UNIX multi-processor file servers, for map software development;

- Silicon Graphics UNIX multi-processor file server for production;

- Silicon Graphics UNIX multi-processor file server to research and develop new technologies (such as commercial off-the-shelf software to replace existing internally developed software).

Geography Distributive Production Clusters

We have found that a cost-effective means of getting work done in the Regional Census Centers is to use multiple application servers that are accessed by PCs using X-windows emulation software. We have also found that this configuration is more cost-effective than graphics workstations/disk farms or a combination of graphics workstations/disk farms and PCs. With the shift to PCs/application servers, we have reduced the original hardware cost estimate for supporting the Regional Census Centers.

- Regional Census Center/Beta Site/National Processing Center

  Included are multiple Silicon Graphics UNIX multi-processor file servers with at least 100 GB disk storage for map and TIGER/MAF update production work. Associated with these servers are variable numbers (based on production requirements) of PCs and Silicon Graphics graphic workstations.

- Headquarters

  - Multiple Silicon Graphics UNIX multi-processor file servers with at least 200 GB disk storage for automated processing of local/commercial digital spatial data files, support for Oracle applications, backup services, and Intranet applications;

  - Multiple Windows NT, Novell, and UNIX servers to support office automation applications such as e-mail, scheduling, Primavera, SAS, the Geographic Information System, and Oracle. Associated with these servers are Intel and Motorola based PCs; and

  - a Silicon Graphics UNIX multi-processor file server for Data Access and Dissemination System support.

Research Server

- Silicon Graphics UNIX multi-processor file server with at least 100 GB disk storage and 1 GB memory;

- Software development for the UNIX machines and UNIX workstations in the Regional Census Centers, the National Processing Center and at Headquarters, using ANSI C, C++, Tcl/Tk, and Perl. All relational applications will use the U.S. Census Bureau standard Oracle database.

Other devices include:

- **Map output devices:** support boundary collection and validation activities, to build and maintain the linked TIGER / Master Address File databases, and to let state and local officials preview the status of information in the TIGER database by providing them with maps they can update and return to the U.S. Census Bureau.

- **E-Size color printers:** needed to maintain the TIGER /Master Address File databases through the expanded Boundary and Annexation Survey in 1999, Census 2000, and other geographic programs.

- **Graphic workstations:** required to develop application software and to update and maintain the TIGER /Master Address Files databases.

- **PCs:** to replace outdated and incompatible office automation equipment in Headquarters and to meet U.S. Census Bureau standards for use as an interface to TIGER /Master Address File databases by subject matter staff. Additional PCs are required to access the TIGER /Master Address File database in the Regional Census Centers and the National Processing Center for updating and maintaining addresses. We are using a three-year lifecycle for replacing the PCs. By July 1 of each year, we will determine which PCs will have priority for replacement in the following fiscal year.

- **UNIX multi-processor servers:** for use in the Regional Census Centers, National Processing Center, and Headquarters, for processing maps and other TIGER /Master Address File batch operations. Each server will have a large disk farm (minimum 100 GB) and upward scalability. Each will have a minimum of 1 GB of memory.

- **UNIX servers:** we require dedicated servers to process local spatial data for modeling to the TIGER database and for supporting Oracle Relational Database Management System applications, Data Access and Dissemination System development, backup services and Intranet applications.

- **Research server:** required to support Headquarters development activities and test new technologies.

2.1.2 Geographic Support System Progress Against Planned Milestones

Geographic Support System Milestones, FY 98					
Description	Estimated		Actual		Progress to Date
	Start Date	Finish Date	Start Date	Finish Date	
Demographic Census Entities: Military Installations	04/97	03/98		03/98	Completed.

Geographic Support System Milestones, FY 99					
Description	Estimated		Actual		Progress to Date
	Start Date	Finish Date	Start Date	Finish Date	
Geographic Services – Participant Statistical Entities: 1998 Boundary and annexation survey	06/97	10/98		10/98	Completed.
Redistricting Program: Phase I-Block Boundary Suggestion Program	04/94	03/99		03/99	Completed.
Upgrade and replace database and application servers for 1999	12/98	03/99		03/99	Completed.
21st Century MAF/TIGER Initiative Business Case	01/99	05/99		05/99	Completed.
Local Update of Census Address (LUCA): Design appeals Process-Decennial LUCA	10/96	06/99		06/99	Completed.
Create MAF for Non-City Style Address Areas: Implement Address Listing	10/96	07/99			In progress.
MAF Improvement for City-Style Address Areas: Block Canvassing	09/97	07/99			In progress.
Obtain desktop graphic workstations for research work for 1999	07/99	08/99			
Obtain large format map printer (E-size)	08/98	09/99			In progress.
Obtain additional laser and inkjet printers to support TIGER/MAF production efforts	03/99	09/99			In progress.

Geographic Support System Milestones, FY 00					
Description	Estimated		Actual		Progress to Date
	Start Date	Finish Date	Start Date	Finish Date	
Local Update of Census Address: Implement LUCA	07/97	10/99			In progress.
Geographic Services – Participant Statistical Entities: 1999 Boundary and Annexation Survey	06/98	11/99			In progress.
Build MAF	01/96	12/99			In progress.
Link City – Style MAF addresses to TIGER	01/95	01/00			In progress.
MAF Improvement of City-Style Address Areas: Targeted Map Updates	03/97	01/00			In progress.
Determine 2001 upgrade and replacement requirements for database and application servers	10/99	01/00			
Demographic Census Entities: Public Use Microdata Samples	06/97	02/00			In progress.
Traffic Analysis Zones	11/97	03/00			In progress.
Reduce number of network protocols to one: TCP/IP	04/99	03/00			In progress.
Reduce number of network operating systems to two: NFS, Common Internet Filing System	04/99	03/00			In progress.
Special Place/Group Quarters Inventory	04/96	04/00			In progress.
Geographic Services – Participant statistical Entities	06/96	04/00			In progress.
Local Update of Census Address: Implement Decennial Appeals Process	06/99	04/00			In progress.
Zip Code Tabulation Areas	04/97	08/00			In progress.
Final Boundary Validation Process	12/99	08/00			
Geographic Services – Participant Statistical Entities: 2000 Boundary and annexation survey	05/99	09/00			In progress.

Geographic Support System Milestones, FY 01					
Description	Estimated		Actual		Progress to Date
	Start Date	Finish Date	Start Date	Finish Date	
Redistricting Program: Phase 2-Voting Districts/Legislative Districts	04/97	10/00			In progress.
TIGER/MAF/DMAF Linkages/Transactions	11/96	11/00			In progress.
Special Geographic Products	01/96	01/01			In progress.
Geographic Comparability Files	11/99	01/01			
Determine 2002 upgrade and replacement requirements for database and application servers	10/00	01/01			
Upgrade and replace database and application servers for 2002	10/00	01/01			
TIGER/Line Products	08/98	02/01			In progress.
Tract/Voting District Maps	08/98	03/01			In progress.
County Subdivision Maps	08/98	03/01			In progress.
County Block Maps	08/98	07/01			In progress.
Reference Maps for 2000 Tabulations Geography	09/98	07/01			In progress.
Boundary Files for 2000 Tabulation	01/99	07/01			In progress.
Statistical Maps for 2000 Tabulation Geography	05/99	07/01			In progress.

Geographic Support System Milestones, FY 02					
Description	Estimated		Actual		Progress to Date
	Start Date	Finish Date	Start Date	Finish Date	
Demographic census Entities: Urban/Rural	04/97	11/01			In progress.
Determine 2003 upgrade and replacement requirements for database and application servers	10/01	01/02			
Upgrade and replace database and application servers for 2003	10/01	01/02			
Boundary Files for Post – 2000 Demographic Entities	10/01	02/02			
Reference Maps for Post – 2000 Demographic Entities	10/01	09/02			

Geographic Support System Milestones, FY 03					
Description	Estimated		Actual		Progress to Date
	Start Date	Finish Date	Start Date	Finish Date	
Congressional District Atlas	02/02	01/03			
Boundary Files – 108th Congressional Districts	09/02	01/03			
Congressional Districts (106th) and (108th)	02/98	04/03			In progress.
Demographic Census Entities: Metropolitan Areas	06/97	04/03			In progress.
Population and Housing Atlas	03/02	09/03			

2.1.3 Geographic Support System Performance Measures

In last year's Operational IT Plan the Geography Division identified 11 performance goals for the Geographic Support System. However, we found these goals had two significant flaws: first, they were project goals rather than IT performance goals and, second, the statistics generated for these projects did not produce useful performance measures. The key measure was timely delivery of various geographic products, but recording whether a deadline is met is not, in and of itself, a very useful performance metric. It does little to explain why a deadline was met or missed since there may be many factors involved. To be useful, performance metrics need to be more specific and focused. For these reasons, we replaced the original performance goals with the four new goals noted below:

GSS Performance Measures			
Performance Goals	Performance Measures	Target Performance	Current Performance
Purchase hardware and software to support GSS programs	Average time to enter purchase request into system	Within 5 days	*
Distribute hardware and software	Time to deliver to end user	Within 5 days after receipt	*
Respond to Help Desk requests**	Average response time to resolve	Within 4 hours	*
Quality assurance of Geography products	Percent of products returned for rework	Less than 1%	*

* An automated system to establish baselines and measure performance is in progress.
** Since our help desk supports both production and office automation IT resources, this performance goal is also included in section 3.3 Geographic Support System Infrastructure Performance Measures.

The Geographic Products Quality Assurance Team designs and implements a quality assurance program that ensures that all Geography Division's products meet the sponsor's specifications. As necessary, the team assists the Division's branches and staffs in the quality assurance process; in addition, the team also does the following:

- **develops quality assurance procedures that are implemented on internal processes;**
- **works with Geography offices to design methods to assess and report the quality of TIGER and Master Address File products and data; and**
- **works with the Decennial Statistical Studies Division to ensure that the quality assurance processes are statistically-based and conform to U.S. Census Bureau standards;**

The team will design a reporting system that captures the results of all implemented quality assurance activity.

2.1.4 Geographic Support System Risks

We foresee staffing as one of our major risks. Hiring and retaining competent technical staff is becoming increasingly difficult in the federal government. Our recent experience in attempting to obtain qualified computer programmers indicates that the federal government salary levels are significantly below that of the private sector. To address our inability to attract qualified computer programmers, we are making more extensive use of contract programmers. With more frequent turnover of contract staff, use of contract programmers introduces additional costs to continue to train them on the unique features of the TIGER /Master Address File system. Use of task-based contract programmers may also increase the overall cost of developing and maintaining the software system. We have accounted for the increased use of task-based contract programmers in our current budget estimates.

We are working on business continuity plans to address a number of risks that, if they occurred, could conceivably disable the Geographic Support System. In 1998, the IT Directorate led the effort to create a continuity plan for the Bowie Computer Center, where the Geographic Support System OpenVMS computer cluster is located (along with other large-scale systems used by other U.S. Census Bureau program areas). Based on this example, we are developing continuity plans by site location rather than by system, such as the Geographic Support System. We identified the following site locations as needing continuity plans:

- **the Regional Census Centers;**
- **the National Processing Center; and**
- **Headquarters.**

We are working with the Field and Decennial Directorates to create separate plans for each Regional Census Center; we are also working with Field to create a plan for the National Processing Center. Finally, we are creating a plan for Headquarters. Each of these plans is in progress and we expect to complete them by the end of 1999. All of these continuity plans are based on the distributed character of TIGER /Master Address File processing and on having duplicate hardware and software configurations at the Regional Census Centers, the National Processing Center, and Headquarters. Thus a processing disruption at any site will cause that processing to be moved to another site until the disrupted site can be repaired.

We are also working on security plans for the Geographic Support System. Security plans, like the continuity plans, are being developed for each site where a portion of this system resides. We are working with the Security Office to determine the final aspects of the plans. Problems that still must be resolved include defining a computer system for purposes of the security plans, identifying the security standards that the U.S. Census Bureau uses, and deciding how these standards should be implemented in the Geographic Support System.

2.1.5 Geographic Support System References

The Geographic Support System is supported by the following planning documents:

- **Budget Submission for FY 2001, dated June 1999;**
- **1999 Strategic IT Plan, dated December 18, 1998, pages 77-81, 98;**
- ***Early Decennial Census Operations*, Requirement Initiative DC02-9702, approved October 3, 1997;**
- ***Large Format Printers*, Requirement Initiative DC01-9703, approved August 15, 1997;**
- ***Computer Hardware and Software*, Requirement Initiative DC01-9701, approved August 5, 1997;**
- ***Geography Workstations*, Requirement Initiative DC01-9505, approved August 11, 1995; and**
- ***A Geographic Support System for the U.S. Bureau of the Census: Functional Requirements for the System*, SPAD System, Ltd., Reston, VA, February 1983.**

3.0 Geography Division Infrastructure

Desktop computers, although used for office automation, are an integral resource of the Geographic Support System. The desktop computers are used extensively for Geographic Support System production, usually as an X-window server connected by the network to a UNIX server running applications such as GUS-X. Other times, the desktop computers run commercial off-the-shelf Geographic Information Systems software (ArcInfo, ArcView, Maptitude, or MapInfo) to analyze the Master Address File, TIGER , or related information.

The Geography Division manages and supports its own desktop computers and network operating systems through the Computer Support Branch in the Geography Division.

3.1 Geographic Support System Infrastructure Description

The Geography Division's Geographic Support System infrastructure consists of:

- **one Novell Netware 4.11 server (Compaq at 200 MHz);**
- **four Microsoft Windows NT 4.0 servers (one Dell at dual 200 MHz, two Dells at 400 MHz, oneMidwest Micro at 233 MHz);**
- **one Appleshare 4.1 server (Apple at 150 MHz);**
- **one SMTP e-mail server (one Silicon Graphics at 225 MHz);**
- **two calendaring servers (one Apple at 150 MHz, one Hewlett Packard);**
- **282 Microsoft Windows 95 and NT desktop computers;**
- **40 Apple Macintosh 8.1 and 8.5 desktop computers;**
- **31 laser printers;**
- **four inkjet printers; and**
- **one pin printer.**

In addition, approximately 60 desktop computers are used for software development for the Geographic Support System.

We are constantly improving the GSS infrastructure. Within the year, we expect the infrastructure to consist of:

- **one Novell Netware 4.11 server (Compaq at 200 MHz);**
- **six Microsoft Windows NT 4.0 servers (six Dells at dual 500 MHz);**
- **one SMTP e-mail server (Silicon Graphics at dual 300 MHz);**
- **one calendaring server (SUN at 175 MHz);**
- **290 Microsoft Windows 95 and NT desk-top computers;**
- **40 Apple Macintosh 8.5 desktop computers;**
- **35 laser printers; and**
- **six inkjet printers.**

Ethernet connects all of the Geographic Support System infrastructure network devices to the U.S. Census Bureau's Wide Area Network. Five virtual Local Area Networks were installed in August 1996 when the Geography Division moved to Washington Plaza (WP1); since then, the IT Directorate has upgraded the router. This year, the IT Directorate is upgrading our connection

from the WP1 building to the U.S. Census Bureau's Wide Area Network from 10 Mbps fiber to 155 Mbps Asynchronous Transfer Mode (ATM). The ATM link will include hardware encryption. At the same time, additional 100 Mbps switches will be installed to increase Local Area Network capacity. The Geography Division is funding these upgrades.

We currently run four network operating systems; these are:

- **Network Filing System, usually to connect UNIX computers;**
- **Server Message Block, usually to connect Windows NT computers;**
- **Appleshare, usually to connect Macintosh computers; and**
- **Netware, usually to connect Windows computers.**

Each of these network operating systems uses a different protocol on the network, namely TCP, NetBios, AppleTalk, and IPX. We are working with the IT Directorate to reduce the number of protocols to one, TCP/IP. We expect, within the next year, to also reduce our network operating systems to these:

- **Network Filing System, usually to connect UNIX computers;**
- **Common Internet Filing System, usually to connect all other computers; and**
- **NetWare to connect legacy systems in the rest of the U.S. Census Bureau.**

3.2 Geographic Support System Infrastructure Progress Against Planned Milestones

Geographic Support System Infrastructure Milestones, FY 98					
Description	Estimated		Actual		Progress to Date
	Start Date	Finish Date	Start Date	Finish Date	
No milestones to report					

Geographic Support System Infrastructure Milestones, FY 99					
Description	Estimated		Actual		Progress to Date
	Start Date	Finish Date	Start Date	Finish Date	
Obtain PC replacements for 2000	10/98	09/99	11/98		Purchased 50 PCs

Geographic Support System Infrastructure Milestones, FY 00					
Description	Estimated		Actual		Progress to Date
	Start Date	Finish Date	Start Date	Finish Date	
Determine PC replacement requirements for 2001	10/99	01/00			

Geographic Support System Infrastructure Milestones, FY 01					
Description	Estimated		Actual		Progress to Date
	Start Date	Finish Date	Start Date	Finish Date	
Determine PC replacement requirements for 2002	10/00	01/01			
Obtain PC replacement requirements for 2001	01/01	09/01			

Geographic Support System Infrastructure Milestones, FY 02					
Description	Estimated		Actual		Progress to Date
	Start Date	Finish Date	Start Date	Finish Date	
Determine PC replacement requirements for 2003	10/01	01/02			
Obtain PC replacement requirements for 2002	01/02	09/02			

Geographic Support System Infrastructure Milestones, FY 03					
Description	Estimated		Actual		Progress to Date
	Start Date	Finish Date	Start Date	Finish Date	
Determine PC replacement requirements for 2004	10/02	01/03			
Obtain PC replacement requirements for 2003	01/03	09/03			

3.3 Geographic Support System Infrastructure Performance Measures

A typical performance measure for infrastructure staff is help desk responsiveness. It was determined during the writing of last year's Operational IT Plan that we should purchase and implement more rigorous help desk software that would track and analyze the responsiveness of the Geography Division infrastructure staff. This project is in the investigative stage; implementation is still expected to be this year.

We have added a performance measure to the Geographic Support System Infrastructure to respond to help desk requests*. We will begin reporting once we have implemented the help desk.

*Since our help desk supports both production and office automation IT resources, this performance goal is also included in section 2.3.1 Geographic Support System Performance Measures.

GSS Performance Measures			
Performance Goals	**Performance Measures**	**Target Performance**	**Current Performance**
Respond to Help Desk requests	**Average response time to resolve**	**Within 4 hours**	**Not yet implemented**

3.4 Geographic Support System Infrastructure Risks

Hiring and retaining competent staff continues to be a central risk for the Geography Division infrastructure. A U.S. Census Bureau-sponsored job fair was held at Headquarters in late January 1999 and a large number of computer specialists (Series 0334, grades 5-12) were interviewed for many positions throughout the Geography Division. Since the job fair, we have not been able to hire any computer specialists.

A cursory review of the difficulty in hiring computer specialists in the Geography Division gives these observations:

- **the government-wide general pay schedule is not competitive for computer specialists;**
- **for computer specialists, the U.S. Census Bureau participates in an Office of Personnel Management-sponsored merit selection process that is slow and error-prone;**
- **computer specialist candidates lacking up-to-date skills are not as valuable because of the rapid technology changes in the computer field.**

3.5 Geographic Support System Infrastructure References

The Geographic Support System Infrastructure is supported by the following planning documents:

- ***Enterprise Printer Resources*, Requirement Initiative PRMAP9701, approved May 13, 1998;**
- ***Macintosh Computers*, Requirement Initiative GE06-9901, approved August 5, 1997; and**
- ***Enterprise Personal Computer Management and Acquisition Plan*, Requirement Initiative PCMAP9601, approved December 5, 1995.**