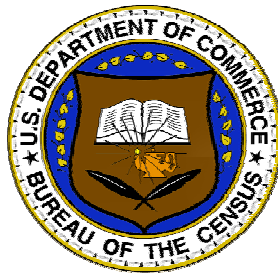


**U.S. Census Bureau
Geography Division
MAF/TIGER Redesign**



Project Overview

December 20, 2004

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1. BACKGROUND

Objective 2 of the MAF/TIGER Enhancements Program (MTEP) is to replace the existing MAF (Master Address File) and TIGER (Topologically Integrated Geographic Encoding and Referencing) Systems that were developed during the 1980s. These systems are “home-grown” database systems, and utilize applications software that was developed almost entirely “in-house”, without the benefit of Commercial Off-The-Shelf (COTS) software. The replacement system will:

- Use an open commercial database system (Oracle) for data storage and manipulation.
- Use COTS and Geographic Information System (GIS) software to the maximum extent possible in the development of applications.
- Adhere to Level 2 of the Software Engineering Institute’s Capability Maturity Model (CMM).
- Implement a more flexible, open design to allow fast, reliable responses to changes in requirements.
- Merge the existing separate databases (MAF, TIGER) into a single integrated database.
- Use new technology to improve the functionality of the MAF/TIGER system, and to allow easier access for viewing and updating.

The existing, antiquated systems have performed well, but are rapidly becoming obsolete. The new system will address a number of problems or shortcomings that exist with the current system, such as:

- The existing TIGER database system (TIGERdb) does not allow concurrent multi-user access. Only one batch or interactive user can have write access to a file at a time. This leads to bottlenecks in both batch and interactive production operations that update the data. Use of a commercial database will allow concurrent multi-user access.
- Prospective employees are familiar with commercial databases, but not with TIGERdb. Because TIGERdb uses obsolete technology and is difficult to learn, recruiting is handicapped. In addition, when new employees arrive, intensive training is required before they can become productive.
- The existing system does not interface well with new technology. Web-based access is extremely cumbersome. Commercial databases come with Web development tools and applications can be Web-enabled easily.
- The existing systems are inflexible. Changes are difficult to implement, and the risk of changes having undesired effects is significant. Commercial databases are much easier to expand or modify, and an open approach to applications software development will expedite the process of implementing new or revised applications, and lessen risks when making modifications.

- The existing systems do not lend themselves to migrating, translating, and sharing data. An open, well-documented commercial system utilizing COTS and GIS software will facilitate data sharing in a variety of circumstances:
 - Within the Census Bureau, including to and from the mobile computing devices planned for use in field operations.
 - With state/local/tribal government geographic partners.
 - With other federal agencies.
 - With other external customers.
- The replacement of the existing county partition-based systems with a seamless national database will provide greater flexibility in terms of product delivery partitioning, and will lessen edge-matching problems.

2. RELATIONSHIP TO OBJECTIVE 1 OF THE MAF/TIGER ENHANCEMENTS PROGRAM

The goal of Objective 1 of the MAF/TIGER Enhancements Program (MTEP) is to correct the locations of streets and other map features in the TIGERdB. The improved coordinates and associated metadata can be stored and managed in both the existing legacy TIGER system and the newly designed database. The Objective 1 coordinate enhancement has started already, and the improved positions of features are reflected in the legacy database. When the migration occurs in 2006, the improved coordinates will be moved to the new system. However, there will still be a number of counties, at that point, that will not have gone through coordinate correction. Some of this coordinate enhancement software (such as the applications that upload the improved data into live TIGER) will need to be converted to run on the new database.

3. RISKS

Implementation of any new system, designed to resolve a set of longstanding existing problems, often brings with it an entirely different set of problems, challenges, and risks. The MAF/TIGER Redesign will not be an exception. Table 1 lists some of the major risks and challenges:

Table 1: Objective 2 Risks

Risk	Mitigation
Extensive use of commercial GIS software could result in excessive dependence on a particular vendor, as far as software modifications and new releases. In addition, extensive reliance on a single vendor ties our success to the success/health of that company.	Use an open system database design to the extent possible that can be accessed by and interface with applications software packages from a variety of GIS vendors. Consider corporate health and stability as a criterion in the COTS selection process.

Risk	Mitigation
COTS/GIS software may not provide all required functionality.	Conduct thorough evaluations of COTS products, including hands-on testing. Plan to contract for development of applications software to extend the functionality of the COTS/GIS software where necessary.
Commercial databases require more computer resources (disk, memory, CPU) than TIGERdb.	Plan to acquire additional hardware. Perform capacity testing on large-scale prototypes. Ensure access to technically savvy database administration and application consulting help, to address database tuning and application performance issues.
The MTEP Objective 2 budget does not include money to purchase new hardware. The existing hardware must be used for the legacy system as the new system is being brought on line. The two must run concurrently for more than a year. Further, the existing hardware is aging, and will be inadequate to support the new database. Availability of adequate hardware will depend on the ability of the Census Bureau to identify funds to procure it.	Work with the IT area on a corporate approach to providing large UNIX or Linux-based servers to meet Bureau computing demands. In conjunction with SSD, develop and implement plans to test the viability of blade servers to support the redesigned MAF/TIGER. Attempt to find the most cost-effective configuration to provide the needed computing power.
Developing/maintaining two systems simultaneously could strain Geography Division resources.	Develop program plan to identify resource requirements. Use contracts to obtain developmental support and assistance, to the extent possible, and contract out any whole components or activities that are appropriate. Establish a Configuration Control Board (CCB) to review and approve changes to legacy software.

Risk	Mitigation
<p>While many GIS systems use a “layered” approach, with largely independent data sets for different feature types (e.g., roads, hydrography, boundaries, etc.), the highly interrelated nature of Census geographic features, such as roads, blocks, address ranges, and MAF coordinate points, dictates a more integrated approach. The existing TIGER system manages this with a persistent topology approach, and the new database will as well, using Oracle’s new Spatial Topology Data Model. While Spatial Topology Data Model appears to provide much of the functionality in the existing TIGERdb system, it is a relatively new product, and as such, subject to a higher degree of risk than other COTS tools.</p>	<p>Participate as Beta testers of Oracle Spatial Topology Data Model. Provide feedback to Oracle on bugs and potential functionality enhancements. Compare results to existing TIGERdb Topology.</p>
<p>While all of the various COTS tool selections bring some degree of risk, the selection of COTS GIS update software is the most challenging. Many vendors tie their update tools to specific proprietary database formats, and this is not an acceptable approach for MAF/TIGER, especially given the volume of our batch processing. Also, the COTS update tool will have to manage concurrent access and locking mechanisms, as well as management of business rules consistent with the batch update environment.</p>	<p>Pursue tools that support an open J2EE architecture. Develop prototypes to demonstrate concurrent access and locking capabilities, business rule implementation, and performance.</p>
<p>Any changes to or delays in approval of program funding, or inability to acquire funding due to changes in program requirements throughout the program life cycle, will reduce the ability to meet all program objectives.</p>	<ul style="list-style-type: none"> • Timely identification and submission of funding requirements. • Contingency funding reserves. • Continual review of program costs. • Periodic evaluation of program alternatives in the event of changes in funding.

4. CURRENT STATUS (DECEMBER 2004)

4.1. Requirements

- The System Functional Requirements have been reviewed and baselined.
- The System Security and Privacy Requirements have been reviewed and baselined.
- The System Data Content Requirements have been reviewed and baselined.
- The System Hardware and Performance Requirements have been reviewed and baselined.
- A Change Control Board has been chartered to review requests for changes to requirements.
- Requirements are maintained in a COTS repository (DOORS), which provides traceability from source through development and testing.
- Teams have been formed and are working to develop software specifications for Workflow Control, Interactive Update, Data Migration, Geocoding/Matching, Mapping and Business Rules.

4.2. Project Management

- A MAF/TIGER Redesign Steering Committee was formed in February 2003 and meets every month to review status and resolve issues.
- The Project Management Plan is complete.
- The Software Development Plan is complete.
- The Training Program Plan is complete.
- The Project Communication Plan is complete.
- The Project Configuration Management Plan is complete.
- The Risk Management Plan is complete.
- A Risk Register, including risk analysis and mitigation, is maintained and updated at quarterly risk management meetings.
- A work breakdown structure and associated schedule are maintained in the Geography Division (GEO) MIS and reviewed on a weekly basis. Progress and hours are reported on-line, using Primavera Progress Reporter, to support Earned Value Management analysis of the project.
- Based on recommendations from the Department of Commerce's Office of Inspector General, and the National Academy of Sciences, formal software estimates were developed, with the intent of evaluating the viability of the budget, scope, and schedule for the project. This resulted in a re-baselining of the project in February 2004, with some modifications in scope and some of the intermediate milestones, but no change to the end date of September 30, 2006.

4.3. Business Rules

- Work continues to gather and document business rules for database integrity, database access and database maintenance.
- Rules are being entered into the Requirements Management tool (DOORS) and posted on the portal for review by stakeholders.
- Work on a business rules implementation strategy has started.

4.4. COTS Software Market Research

- The Data Storage Environment Market Research is complete and documented.
- The Interactive Update Software Market Research is complete and documented.
- The Geocoding Market Research is complete and documented.
- The Address Standardizer Market Research is complete and documented.
- Groups are developing use cases, contacting vendors, and refining selection criteria for the following areas: mapping applications and workflow control software.

4.5. Architecture

- The high-level system architecture (Planner and Owner rows of Architecture Framework) is complete. The architecture is accessible to Census Bureau stakeholders via the GEO Portal.
- The Logical Database Design is complete.
- A physical database prototype has been designed.

4.6. Software Development

- Work has begun on the data migration software, to move data from the legacy MAF, TIGER and GEOCAT databases to the physical MAF/TIGER database prototype.
- The Project Test Plan is complete.

4.7. Software Quality Assurance

- The Software Quality Assurance (SQA) Plan is complete.
- The project team has been trained on SQA responsibilities.
- The first Requirements Management Audit is complete.
- The first Project Planning Audit is complete.
- The first Project Tracking and Oversight audit is complete.
- The first independent audit of the Software Quality Assurance is complete.

- The first Risk Management Audit is complete.
- The first Configuration Management Audit is complete.

4.8. Documents in Progress

Work continues to document plans, software requirements and architecture for the MTR project. As of December 2004, the following project documents are in various stages of completion:

- System Deployment Plan (first draft)
- Technology Standards Profile (first draft)
- MAF/TIGER Redesign Glossary (updated continuously)
- Software Requirements Specifications (ongoing)
- Designer Level Architecture Artifacts (ongoing)

5. COTS TOOL SELECTION

One of the objectives of the MAF/TIGER Redesign is to utilize commercially available development and application tools to the greatest extent possible. Table 2 identifies COTS products that have been selected as of December 2004.

Table 2: COTS Tool Selection

Function	Tool
Database	Oracle
Spatial Storage	Oracle Spatial Topology Data Model
Requirements	DOORS
Configuration Management	Serena Version Manager
Document Management	Oracle Portal
System Architecture	Metis, Oracle Portal
Database Modeling	Oracle Designer
Development Environment	JDeveloper
Extraction/Transform/Load	Oracle Replication, Warehouse Builder