

A Vision for a 21ST Century MAF/TIGER *

Prepared by
Robert W. Marx
Chief, Geography Division

I. OVERVIEW

The Census Bureau has always been an innovator and leader in the use of automation to achieve its goals. In no other area at the Census Bureau has the use of automation been more far-reaching or more successful than in the **MAF and the TIGER data base** (called “MAF/TIGER data bases” for the balance of this document). The MAF/TIGER data bases have become a **national resource**. They are used not only to support the various censuses and surveys at the Census Bureau, but also by other Federal agencies, the Congress, numerous state, local, and tribal governments, and many private sector and academic organizations. Primarily, the MAF/TIGER data bases are used to support the mapping, geographic analysis, and GIS activities of the Census Bureau in meeting the statistical data needs of its many and varied customers.

Although the MAF/TIGER data bases have been able, thus far, to meet and exceed the Census Bureau’s Census 2000 geographic requirements, this likely will not be true for the 21ST Century. The current MAF/TIGER data bases must be significantly upgraded and redone to overcome significant limitations identified by Census 2000 and “**launch**” the **Bureau’s statistical programs into the 21ST Century**.

As currently designed and implemented the MAF/TIGER data bases:

- **Limit** the sources that can be used to assure intercensal **completeness** of the Master Address File (MAF) and integral TIGER data bases and **impede** the ability of the Bureau’s data collection operations to adopt **an integrated address list / geographic update / data collection instrument**.
- **Preclude more effective** address list and geographic information **partnerships** with those state, local, and tribal governments that have high quality address, street, boundary, and related geographic information.
- **Diminish** the ability of the TIGER/MAF data bases to provide the highest possible **quality** in the geographic products and services prepared to support the Bureau’s data collection activities and for the Bureau’s data product customers.

* The views expressed in this paper are those of the author and have not been approved by the U.S. Census Bureau or the Department of Commerce. They are presented to stimulate the thinking of the Panel on the Research on 2010 and Future Census Methods.

Approach Envisioned

The Census Bureau needs to further develop the capabilities of its MAF/TIGER data bases beyond the level achieved for Census 2000 and prepare for significantly more automation in the 21st Century. The specific goals that must be achieved are to:

- Improve **street and other map feature locations** in the TIGER data base to meet NSDI requirements, **add accurate housing unit locations** for each MAF address, and **enhance feature change detection methodology to provide more timely updates**.
- Expand **geographic partnership programs** that update the MAF/TIGER data bases. Assure that agreements are implemented with all state, local, and tribal partners that wish to collaborate in the improvement and update of MAF/TIGER information.
- Modernize the **processing environment** for the MAF/TIGER data bases.
- Implement an ongoing **evaluation process** for the MAF/TIGER data bases.

Accomplishing the needed improvements to the MAF/TIGER data bases will allow the sponsoring and participating organizations that depend on the Bureau for their statistical data and their geographic infrastructure to begin activities that will further develop the already impressive capabilities of the MAF/TIGER data bases by using new technology, commercial off-the-shelf (COTS) software, and new address and geographic data sources.

New Program Objectives for the Post-2000 Census Era

- **Improve the locational accuracy** of the street / road information in the TIGER data base (to facilitate adoption of GPS technology) for guiding field data collection activities and TIGER data base improvement, and to facilitate geographic partnerships with state, local, and tribal organizations that create and use highly accurate address and geographic information, as envisioned under P.L. 103-430 and Executive Order 12906 (the latter is being coordinated by the Federal Geographic Data Committee);
- **Use contractors with expertise in satellite imagery / air photo interpretation** to implement automated systems that will identify new structures and streets (change detection) and determine the exact location of the “doorstep” for every structure address so each can be accurately associated with the census block and current survey segment in which it belongs;
- Use new address list sources and geographic information technology to **automate and integrate the field data collection and address list-geographic update applications** in programs, such as the American Community Survey (ACS), and replace the current paper maps, paper address listings, remaining paper questionnaires, and related paper data collection instruments.
- **Implement a comprehensive plan for periodic MAF/TIGER evaluation** and corrective activities that will guide planning for cost effective coverage improvement operations.
- **Replace existing in-house developed processing system** for the MAF/TIGER data bases with a modern processing system based on **COTS products**.

II. STAKEHOLDERS

Primary users of the MAF/TIGER data bases include the Bureau's program management and data collection organization; all state, local, and tribal governments that desire to work in partnership to improve the MAF/TIGER information; the Federal Geographic Data Committee, the customers for ACS and other current demographic survey data, and ultimately the 2010 decennial census.

Major new stakeholders with new and expanded requirements for the MAF/TIGER data bases are: the American Community Survey (and the Census Address Updating System – CAUS – that it envisions) for improved address list completeness and computer-based data collection techniques; the Integrated Information Solutions (IIS) envisioned by the Bureau's data dissemination planners to achieve fully integrated data tabulations and related geographic information; the Administrative Records Research Program envisioned to improve the quality and timeliness of intercensal statistical data tabulations; and, the 2010 census planning and testing program envisioned to achieve a lower cost census; and all other Census Bureau customers who have come to expect highly accurate and timely geographic products and services.

III. CURRENT APPROACH TO MAF/TIGER MAINTENANCE

Currently the Census Bureau budget proposals support periodically updating the housing unit address and geographic information contained in the MAF/TIGER data bases. These updates meet the minimal needs for basic map, reference file, and address lists required by the periodic censuses, the current sample surveys, the special census program, the current population estimates program, and other research and development activities within the Census Bureau.

The current MAF/TIGER maintenance approach has four basic components:

- **Activities that periodically update the MAF with new housing unit and commercial addresses, and the TIGER data base with associated new streets:** The MAF is crucial to conducting many Census Bureau programs, including the 2010 Decennial Census and the American Community Survey. Continuously updating the MAF/TIGER data bases likely will be the most cost-effective and quality-assured method for providing a current and comprehensive list of housing unit and commercial addresses.
- **Operations that maintain the link between the MAF and the TIGER data base:** This ongoing effort involves linking the MAF to the TIGER data base, which produces maps and documents the inventory and names of all governmental units and other geographic entities used for the Bureau's data tabulations. The TIGER data base also allows the Bureau to assign every housing unit and business establishment address to the correct census block for processing and tabulation.

- **Activities that continue existing geographic partnerships with state, local, and tribal governments:** The Bureau will continue to support a minimal level of partnerships with state, local, and tribal agencies.
- **Activities that assure the quality of geographic support products:** Quality evaluation and correction is an integral part of the planning for the MAF/TIGER data bases.

The activities described above are part of the Census Bureau's current program plan to maintain minimally acceptable MAF/TIGER data bases that the Bureau will be able to use for current censuses and surveys. This baseline level will **not** support the additional automation, accuracy, and timeliness expectations of the customers for 21ST Century MAF/TIGER data bases. To meet the "expectations of our customers in the future," the following **enhancements** must be added to the plans for enhancing the MAF/TIGER data bases:

- **Activities that more frequently update the MAF of housing unit and commercial addresses, that enhance the accuracy of the location information for each address, and that increase the accuracy of the street and other map information in the TIGER data base:** Techniques envisioned include making use of detailed aerial photography and satellite imagery, plus Global Positioning System (GPS) technology, to identify new construction, to provide more precise locations for streets, boundaries, and other map features, and to provide an accurate coordinate for the "doorstep" location of every basic street addresses linked to the mailing address of the structure and other information about the units at each address.
- **Operations that maintain the link between the MAF and the TIGER data base:** The current in-house developed "TIGER db" processing environment used for the MAF/TIGER data bases was the only viable approach when the Census Bureau constructed the TIGER data base in the mid-80s, and it has served the Census Bureau very well for many years. This environment requires the services of highly trained TIGER db programmers to produce custom coded applications for every operation involving data from the MAF/TIGER data bases. The Census Bureau has built a cadre of TIGER db programmers that are extremely capable, but there are never enough of them for the job at hand. More importantly, there are now commercial data processing tools that appear capable of manipulating spatial data, and performing many of the tasks for which these programmers now develop custom applications. To shorten the time for development of new software, the MAF/TIGER data bases need to use off-the-shelf software, where possible, which means moving the MAF/TIGER data bases into a commercial data base setting.
- **Activities that encourage and expand geographic partnership opportunities with state, local, and tribal governments:** To deal effectively with past concerns expressed by officials at all levels of government, and to increase the confidence of Bureau customers using census and survey results, the Bureau needs to provide continued and enhanced opportunities for local and tribal officials to review existing information about the streets, boundaries, and addresses in the MAF/TIGER data bases and needs to listen

and respond to suggestions from local and tribal officials about corrections they believe are necessary. This needs to include an on-going opportunity to review the updated maps and address listings on a “rolling” basis.

- **Activities that assure the quality of products from the MAF/TIGER data bases:** The geographic products quality assurance process needs to enhance the set of statistically sound techniques used for quality evaluations to include all activities that build, update, or enhance the MAF/TIGER data bases, including plans to implement a nationwide ongoing quality improvement program.

IV. BENEFITS ENVISIONED

The Census Bureau’s vision is for a complete, comprehensive, innovative set of MAF/TIGER data bases for the 21st Century. Achieving this vision will allow the Bureau to support improved field operations in the American Community Survey and the other current demographic surveys, to better support the Bureau’s partnership programs with state, local and tribal governments, and ultimately to meet the needs of a far more automated and geographically accurate 2010 census.

- **Modernize MAF/TIGER Software to Prepare for Using New Data Sources**

The migration of MAF/TIGER software to include more COTS products should help the Census Bureau **reduce the costs** associated with future geographic software development and ensure **more timely delivery** of new geographic products. First, using COTS products will eliminate the need to train new computer programmers in the “homegrown” TIGER db software. Second, using COTS products should shorten the time needed to develop future software applications, thus lowering future software development costs and allowing faster delivery of new geographic products and new geographic support processes.

- **Expand Geographic Partnership Programs That Update MAF/TIGER Data Bases**

The envisioned MAF/TIGER data bases will allow the Census Bureau to work with its **geographic partners** in state, local, and tribal offices across the United States in a much more effective way. There likely will be **substantial benefits** to the Bureau from expanding existing partnership programs that **improve the inventory of addresses** in the MAF, **improve the inventory of streets** in the TIGER data base, and **improve the accuracy of addresses, streets, and boundaries**.

- **Implement Systems to Identify New Structures/Streets and Improve Locations of Existing Structures/Streets**

It is important that the MAF/TIGER data bases **improve the appearance** of Census Bureau maps that are used by local and tribal governments, and **improve the ability** of local and tribal governments to automatically match their address lists and maps with

MAF and TIGER. More intensive use of Bureau products will **increase public confidence** in the Bureau's address list and maps, which in turn will increase public confidence in the quality of the resulting statistical data. Improved map appearance increases public confidence that will increase the likelihood of constructive local and tribal government partnership participation.

The envisioned MAF/TIGER data bases will **eliminate the costly and error prone traditional approaches** to address list and map updating operations that require regional and processing center staff to collect and search numerous local/tribal lists, maps, and other sources for new addresses and streets. **Automating** this process will allow contractors to **identify new structures and street changes** easily from nationwide sources of uniform high quality.

The Census Bureau has expended considerable resources on correcting the erroneous public perception that imperfections in the maps compromise the quality and integrity of decennial census statistical data. Improved street accuracy likely will further **improve the Bureau's public image**.

- **Implement Ongoing MAF/TIGER Evaluation Plan**

Constant use of the MAF/TIGER data bases is the **best quality assurance tool** available. Using products from the MAF/TIGER data bases in the Bureau's various censuses and surveys, including the American Community Survey, likely will enable the Census Bureau to identify neighborhoods in the United States and the Island Areas that have an incomplete and/or inaccurate address list and maps, and take steps to correct those deficiencies. These evaluations also offer the prospect that the Bureau will be able to **identify less expensive methods** to ensure uniform high quality in the address list and map information for all areas without requiring field visits everywhere.

- **Modernizing MAF/TIGER software** likely will decrease future software development cycle times, which will **allow faster development** of new geographic products and faster implementation of new geographic support processes.
- **Accurate coordinates** likely will allow field staff to employ **automated navigation** technologies to help them locate themselves and any structures/addresses they are seeking.
- **Accurate coordinates likely** will increase the Bureau's ability to incorporate more **accurate address and geographic data from partners** both inside and outside the Census Bureau, as well as from administrative records sources.
- **Automation of address and map updates** from local and tribal partners likely will **reduce** the Bureau's **reliance on labor-intensive** interactive updating activities for the MAF/TIGER data bases.

V. RISK ANALYSIS

There appear to be significant risks associated with **not** moving the MAF/TIGER data bases into the 21st Century. These risks are likely to include:

- **Inability to automate** the incorporation of high quality **address and map updates** from local and tribal partners holding more current and accurate information in their systems. This is likely to result in **continued dissatisfaction** on the part of partners who have tried hard to work cooperatively with the Bureau. It also is likely to continue the Bureau's reliance on **labor-intensive** interactive updating activities for the MAF/TIGER data bases.
- **Inability** to support the American Community Survey initiative **to automate field address list and associated map update activities**, and to integrate those activities with computer-based data collection operations. This will result in continued reliance on the labor and resource intensive paper maps and paper address lists currently inflicted on interviewers who have their "questionnaire" automated. It also is likely to **preclude adoption of GPS technology** to guide interviewers to their assignments, and require continued reliance on labor-intensive update operations for the MAF/TIGER data bases separate from the on-site field visit.
- **Inability to move** the MAF/TIGER processing environment **to COTS software**. This is likely to result in continued **dependence on** the now **outdated "homegrown" software** system of the 1980s. It also is likely to result in continuing the long lead times currently observed for development of new software applications to update and use the MAF/TIGER data bases.
- **Severely limit** the ability of the MAF/TIGER data bases to incorporate **new addresses from administrative record sources** and validate the locations of those addresses using new structure location information from satellites or detailed aerial photos. This is likely to result in continued dependence on costly and labor-intensive field visits to validate MAF/TIGER information.

VI. NEXT STEPS

The critical next steps to implement the 21st Century MAF/TIGER enhancements are:

- Buy-in by state, local, and tribal geographic partners and other stakeholders.
- Continuation of several current research activities, including existing and additional CRADAs with private sector companies working in the GIS, mapping, and computer technology areas.
- Expansion of external communication processes to assure broad understanding of the need to move the MAF/TIGER data bases into the 21st Century and solicit comments on the envisioned functionality of the enhanced system. This might include "town meetings" and expansion of partnership programs with state, local, and tribal officials.