

BIOGRAPHICAL INFORMATION

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Specific Responsibilities

Dr. Alameh joined the Geospatial Interoperability Group (GIG) of Global Science & Technology (GST) in October 2001. Dr. Alameh serves as an architect on the OpenGIS Consortium's Interoperability Program team (OGC IPTeam): She is currently the lead architect of the Information Interoperability Thread of OGC's OWS2 initiative. Within the IPTeam, she also led the GML3 expressiveness evaluation and SOAP/WSDL/UDDI experiments in the OWS1.2 initiative. She has also served as lead architect of the Critical Infrastructure Protection Initiative-2 (CIPI2), contributing to the design of online versions of the Census bureau BAS and TIGER systems.

Dr. Alameh's other projects at GST include conducting a reuse and reference architecture study for NASA's ESE New Data and Information Systems and Services (NewDISS/SEEDS) program. She also leads geospatial interoperability training courses offered through GIG.

Past Experience

Dr. Alameh previously worked at MIT as a postdoctoral associate, leading the design and development of the MITOrthoTools (extensions to ArcView, MapInfo and GeoMedia packages that allow users to download customized map snippets from OGC Web Mapping Services). She also worked on a variety of consulting projects for Boston-area technical firms.

Educational Information

B.S. – Computer and Communication Engineering, American University of Beirut
M.S. – Civil and Environmental Engineering (Information Technology track), Massachusetts Institute of Technology (MIT)
M.C.P. – Master in City Planning (Information Technology track), MIT
Ph.D. – Computer and Information Systems Engineering, MIT

Professional Memberships

Full member, Sigma XI Scientific Research Honor Society
Member, IEEE and Director, IEEE Women in Engineering Washington DC Chapter
Vice Chair, IEEE Geoscience and Remote Sensing Society DC Chapter
Member, Urban and Regional Information Systems Association (URISA)

Briefing OGC's Critical Infrastructure Protection Initiative Phase 2 (CIPI2)

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ABSTRACT

Sponsored by the Geography Division of the US Census Bureau, The OpenGIS Consortium (OGC)'s second Critical Infrastructure Protection Initiative (CIPI2) focused on issues pertaining to TIGER/GML. CIPI2 tested the use of existing and emerging Standards-Based Off-The-Shelf (SCOTS) software products in the development of two Census prototype systems:

- WebTIGER, a web-based system for serving TIGER data and map images to a browser-based TIGER viewer client as well as other Geospatial One-Stop WFS and WMS viewer clients.

- WebBAS, a web-based system based on OGC interface specifications, including WMS, SLD, WFS and GML for the interactive collection and approval/signing of detailed boundary change information, address break information and base map feature insertion and update. Information collected through the WebBAS system is used to update the NSDI framework data on Governmental Unit Boundaries.

The CIPI2 experience and its lessons-learned are likely to become the basis for the establishment of production WebTIGER and WebBAS systems, creating new markets for products and services that conform with OGC specifications for interoperable OGC Web Services. In the meantime, the new TIGER/GML format is being tested for public acceptance as a standards-based alternative to the TIGER/Line format currently being used to distribute TIGER data.

INTRODUCTION

This paper provides an overview of the second OGC Critical Infrastructure Protection Initiative (CIPI2). CIPI2 was sponsored by the Geography Division of the US Census Bureau, and was supported by three OGC member companies (Syncline Inc., Galdos Inc. and TASC Inc.). The initiative kicked off in November 2002, and culminated in a successful demo to Census management and staff in June of 2003.

The initiative was designed to test the use of OGC web services and standard encodings to collect, maintain and disseminate TIGER data, and consequently to validate improved methods for advancing the Census Bureau's coordination with local government and the National Spatial Data Infrastructure.

This paper represents a summary of CIPI2 based on the author's experience as the OGC lead architect of the initiative. The paper heavily relies on material extracted from OGC

and Census briefings, as well as press releases and demo slides pertaining to the initiative. The paper starts with some background information on e-government and the Geospatial One-Stop, followed by an overview of OGC's Critical Infrastructure Protection initiatives. The paper then proceeds to describe the two prototype systems developed during this initiative:

- WebTIGER, a web-based system for serving TIGER data and map images to a browser-based TIGER viewer client as well as other Geospatial One-Stop WFS and WMS viewer clients.

- WebBAS, a web-based system based on OGC interface specifications, including WMS, SLD, WFS and GML for the interactive collection and approval/signing of detailed boundary change information, address break information and base map feature insertion and update. Information collected through the WebBAS system is used to update the NSDI framework data on Governmental Unit Boundaries.

The paper concludes with a highlight of the major accomplishments as well as key next steps as identified in a press released issued by OGC and Census after the completion of the initiative.

BACKGROUND

Enabling Geospatial E-Government

In 2002, the Federal Office of Management and Budget sponsored 24 e-government initiatives to enhance government efficiency and improve citizen services. The Geospatial One-Stop is the e-government initiative targeted at making it easier, faster and less expensive for all levels of government and the public to access geospatial information (<http://www.geo-one-stop.gov/>). Standard interfaces and web services architectures can support the Geospatial One-Stop goals by enabling seamless access to data and services from multiple agencies and organizations, and helping avoid duplication of efforts by publishing and sharing information about planned data collections.

OGC Critical Infrastructure Protection Initiatives (CIPI)

OGC's CIPI efforts are designed to help advance the ability of cooperating communities to share geospatial information and services as they plan, detect and respond to emergencies and threats (www.opengis.org/functional/page=cipi). The CIPI efforts were motivated by the OMB revising Circular A-16 in August of 2002 (Coordination of geographic information and related spatial data activities to increase federal responsibility in the management of geographic information and spatial data assets).

The Census-sponsored CIPI2 initiative was the second of OGC's CIPI efforts, and was aimed at establishing a prototype system built on a standards-based architecture to (1) demonstrate the next generation Census Bureau information infrastructure, and (2) leverage interoperability work in OGC to address Census' unique geospatial challenges.

At the conclusion of the CIPI2 initiative, the Census Bureau stood up its Geospatial One-Stop Server (snapshot of webpage shown in Figure 1).



Figure 1 Snapshot of Census Geospatial One-Stop Server (<http://aries.geo.census.gov/index.html>)

WEBTIGER

According to the OGC CIPI2 press release, the goal of the WebTIGER Pilot Project (<http://aries.census.gov/WebTIGER/index.html>) is to provide anyone with access to a computer and a connection to the Internet the ability to view maps of and download data from the Census Bureau's TIGER geographic database without the need for specialized software outside of a web browser. Managed by the Bureau's Geography Division, the TIGER database is a nationwide database of streets and address ranges as well as other linear features and legal and statistical areas. The database includes governmental unit boundary information for all legal areas in the US.

One of the main goals of CIPI2 involved assessing the use of TIGER/GML as an alternative to the current TIGER/Line format and to make TIGER map images and TIGER/GML encoded data available through the Geospatial One-Stop portal as part of the NSDI. Because GML is based on the Internet standard XML, GML can reduce reliance of TIGER users on proprietary tools and formats. GML is also optimized to handle simple to complex feature-based spatial data that TIGER data represents.

WebTIGER Architecture

Figure 2 depicts the standards-based architecture followed to build the WebTIGER CIPI2 prototype. The stand-alone TIGER/GML viewer, implemented using html, JavaScript and SVG, allows users to select feature layers for display, zoom to change the viewing scale,

plan to see different areas and click on features to display their attributes. This viewer can provide a wide range of users with the ability to include TIGER data in their applications without the need for building area features from line segments and without having to translate the data from a proprietary format.

The map viewer client enables users to view and download subsets of TIGER data encoded in GML. The TIGER/GML data is served via an OGC Web Feature Service (WFS) capable of traversing XLinks within the GML data. Users may also choose to browse through maps portraying the underlying TIGER/GML data (in SVG, JPEG, PNG or TIFF formats). Those maps are served via an OGC Web Mapping Service (WMS), which styles the GML features retrieved from the WFS using Styled Layer Descriptor (SLD) documents previously created by Census. In order to create those styles, a map style editor was developed by Galdos Inc. allowing Census cartographers to capture the styles they currently use in SLD, and save them in an OGC Web Registry Service (WRS). For more information about the specifications mentioned here, refer to OGC's specifications webpage at <http://www.opengis.org/specs/?page=specs>.

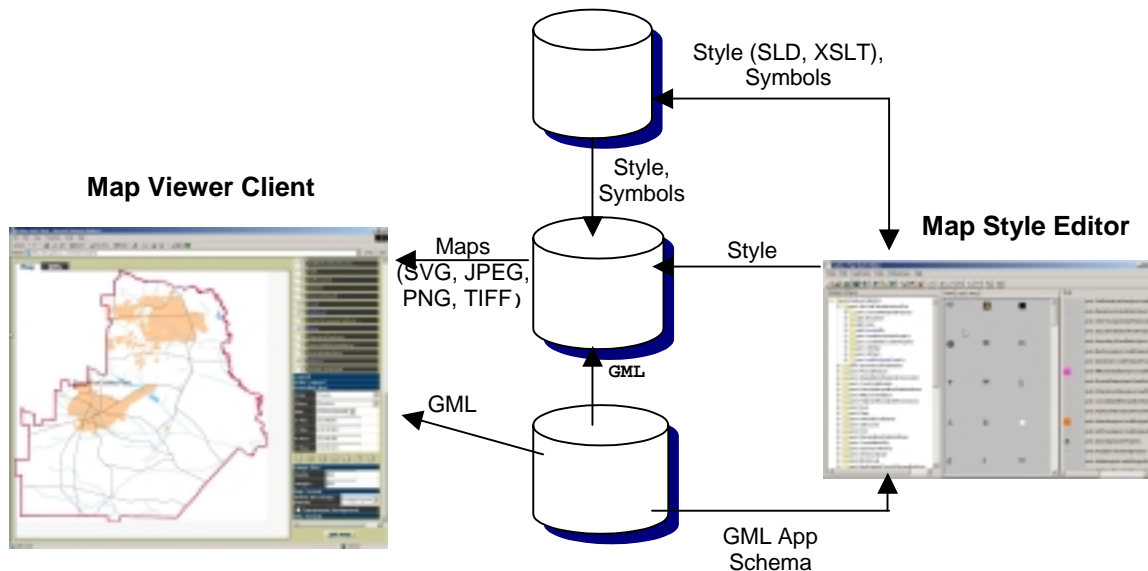


Figure 2 WebTIGER Architecture (Galdos Inc.)

WEBBAS

While WebTIGER facilitates access to Census' TIGER data, it remains true that managing and updating that data is still a big job that involves not only the Census Bureau staff but also thousands of respondents in municipalities across the country. Every year, the Census Bureau conducts a Boundary Annexation Survey (BAS) to update the information about legal boundaries, names, governmental status, and types of municipalities in the US. In order to collect that information, Census has been using a paper-based survey that consists of map sheets, 12 forms, 8 letters, 2 postcards and 12 inserts.

The (WebBAS) pilot project (<http://aries.census.gov/WebBAS/WebBas.html>) was initiated in an effort to

- (1) Reduce time spent by Census employees and local government officials in collecting the BAS data
- (2) Reduce the costs associated with printing, mailing and conducting the surveys
- (3) Improve the survey response rates
- (4) Decrease errors and consequently improve the accuracy of Census' data holdings

WebBAS Architecture

Figure 3 depicts the standards-based architecture followed to build the WebBAS CIPI2 prototype. Heavily relying on various XML-based standard interfaces and encodings, the prototype demonstrated the ability to update TIGER databases directly from online WebBAS survey responses delivered to online users through an easy-to-use graphical user interface.

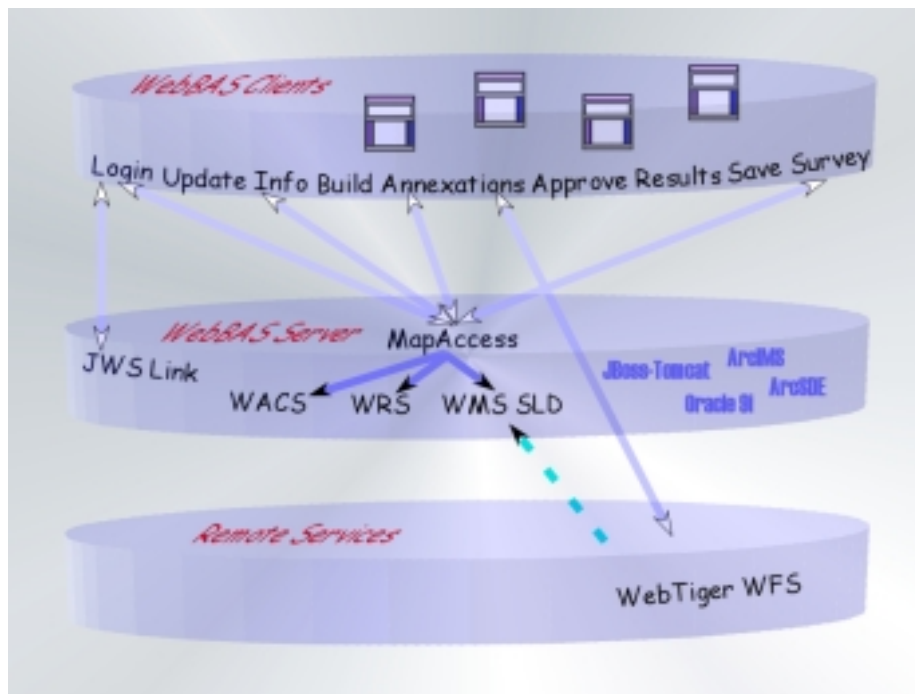


Figure 3 WebBAS Architecture (Syncline Inc.)

In order to implement the above architecture, various challenges had to be overcome by the implementation team of Syncline, Inc., including

- The challenge of translating a lengthy paper survey involving various maps to an online process, and hence creating extensible workflow, configuration and management processes to support the online version of the survey
- The challenge of using TIGER/GML and maintaining/supporting its underlying topological relationships in the feature update process

The CIPI2 WebBAS prototype used the following OGC services

- A WFS, where the TIGER/GML features were retrieved from and portrayed using a WMS (by applying the appropriate SLDs)
- A Web Access Control Service (WACS) which provided restricted access to local government officials, and provided approval and modification authorizations
- A Web Registry Service (WRS) where survey results (or their updates) are saved (possible in the course of multiple user sessions) until they are processed to update the TIGER data. One of the key CIPI2 initiative's deliverables included a design document detailing the post-processing steps required to take the saved surveys and appropriately update the TIGER database.

The online WebBAS survey was tested by various local government officials who confirmed that such an online system is much more efficient than the current paper-based survey, and that a production version would represent a great improvement in service to local governments.

CONCLUSION

The WebTIGER prototype developed as part of the CIPI2 initiative successfully demonstrated the feasibility of custom viewing and dissemination of TIGER data to a wide range of online users using the new TIGER/GML format. Indeed, according to the OGC CIPI2 press release, this new format is being tested by Census for public acceptance as a standards-based alternative to the TIGER/Line currently being used to distribute TIGER data. Based on the success of the prototype, the OGC CIPI2 release recommended that the design for national-scale deployment should be based on this prototype.

The WebBAS prototype, on the other hand, successfully demonstrated the use of TIGER/GML and OGC interfaces in supporting online, transactional updates to the TIGER data. It also demonstrated the viability of an architecture based on OGC standards and web services. Such an architecture can form the basis for progress towards a national production version of the WebBAS system. The architecture and the resulting prototype are solid foundations for a full-scale system architecture, which should be superseded with a detailed analysis of organizational requirements necessary to deploy WebBAS as a fully-operational Census system.

In order to design and develop the described WebTIGER and WebBAS prototypes, the CIPI2 team successfully applied multiple adopted and in the process OGC specifications. These specifications formed the basis for a standards-based architecture that can meet the modernization goals of the Census Bureau. Such an architecture can be used to assure the interoperability of future Census Bureau procurements.

REFERENCES

Geospatial One-Stop Portal WWW Document. <http://www.geo-one-stop.gov>

OpenGIS Consortium Critical Infrastructure Protection Initiatives WWW Document.
<http://www.opengis.org/functional/page=cipi>

OpenGIS Consortium Census Press Release WWW Document.
http://www.opengis.org/press/?page=pressrelease&view=20030626_CIP12_PR

OpenGIS Consortium Specifications WWW Document.
<http://www.opengis.org/specs/?page=specs>

US Census Bureau Geospatial One-Stop Server WWW Document.
<http://aries.geo.census.gov/index.html>

US Census Bureau WebTIGER Pilot Project WWW Document WWW Document.
<http://aries.geo.census.gov/WebTIGER/index.html>

US Census Bureau WebBAS Pilot Project WWW Document.
<http://aries.geo/census.gov/WebBAS/WebBas.html>