

NSDI Cooperative Agreements Program
Category 7: Geospatial Platform Cloud Service Testbed

Interim Report

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Project title: Assessing the Potential Benefits of Hosting Maryland's Basemap in the Cloud

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Executive Summary

In a partnership with the Maryland State Geographic Information Office (GIO), the Center for GIS (CGIS) at Towson University (TU) is leading a project to assess the value of making Maryland's latest basemap data available in Amazon's Cloud-based web services. MD iMap is Maryland's public-facing enterprise GIS infrastructure for providing mapping applications, products, and services online that assist citizens and government employees with managing and presenting data linked to a location. Per the proposed scope of work, CGIS anticipated completing a range of activities that were dependent on technical conditions that existed at the time of proposal submission. However, several unavoidable impediments occurred that necessitated a project restructure. Despite the changed circumstances, CGIS will still be able to achieve the core project goals and is currently preparing a project change request to submit to USGS. The restructure includes a Cloud-based load testing service that enables *simulation* of real-world user application interaction as part of the environment comparison load testing, and involvement by students in the TU Computer Science program. Per original plans, CGIS has obtained the costs for the Amazon hosting environment. Thus far, \$1,567.13 in grant funding has been spent.

Project Narrative

Background

The Center for GIS at Towson University (CGIS) is leading a project to assess the value of making Maryland's latest basemap data (6-inch imagery and Gazetteer) available in Amazon's Cloud-based web services. MD iMap is Maryland's public facing enterprise GIS infrastructure for providing mapping applications, products, and services online that assist citizens and government employees with managing and presenting data linked to a location. The state's 6-inch imagery is maintained by MD DNR and is hosted on the MD iMap infrastructure at Towson University. Per the proposed scope of work, CGIS anticipated completing the following technical activities.

1. Prepare and cache the data in an ArcGIS Server 10.1 compact cache.
 - a. Reproject the data from Maryland State Plane, meters, to Web Mercator coordinates. Data uploaded and published in ArcGIS.com is automatically available to mobile browsers in a JavaScript viewer designed to work well in small-screen devices. Making Maryland's imagery and basemap available in Web Mercator, hosted in the Cloud environment, will enable the browser-based GPS location function to work properly and will speed up map draws on mobile devices.
 - b. Cache the reprojected data.
2. Deploy an Amazon EC2 ArcGIS server infrastructure that has the same level of availability as MD iMap, while taking advantage of Cloud-based scalability to only pay for what is needed at the time, based on system load.
3. Deploy Maryland's basemap and 6-inch imagery data and services on the EC2 environment.
4. Test the published CPU equivalencies by Amazon (Virtual core and EC2 compute units) and compare them from a performance perspective with the current MD iMap infrastructure hardware.
5. Develop and conduct a workshop to enable participants to create a mobile application.
 - a. Teach participants to use the data cached in the Cloud in conjunction with Esri's free ArcGIS.com application development tools to enable mobile mapping.
6. Collaborate with partners and participating organizations to test the real-world use of the system in the Amazon Cloud environment.
 - a. Assist MEMA with using the data as an alternate source for the OSPREY public information mapping application.
7. Work with MEMA and Maryland DNR to test the data and compare performance.
 - a. Based on performance characteristics and real-world utilization of the basemap and imagery services, optimize the cloud-based deployment design.
8. Publish a white paper that fully documents technical tasks and outcomes, deployment costs, performance characteristics, and the estimated cost of ownership for both environments at the current level of utilization.

Current Project Status

In the interim between writing the proposed scope of work and launching the project, several unanticipated impediments to progress have occurred, namely, changes in project partners' plans, a change in the upgrade schedule for the MD iMap infrastructure, and delays in testing due to non-availability of the MD iMap system prior to and during Hurricane Sandy. Over the recent several months,

these changes not only delayed progress, but also turned into significant impediments to implementing the grant project as originally envisioned.

The original scope of work proposed testing of ArcGIS Server (AGS) 10.1 (versus 10.0.x) based on the state's plan to migrate MD iMap to AGS 10.1 and because the server performance in AGS 10.1 was significantly improved over 10.0.x. However, the Maryland State Geographic Information Officer (GIO) required a longer decision period than anticipated to determine when and if the MD iMap infrastructure would be migrated from AGS 10.0.x to 10.1. The final decision to *not* migrate to AGS 10.1 was made on November 2, 2012. Independently of this grant project, the state GIO also requested that CGIS work with Amazon to architect and cost out the requirements for deploying an equivalent hosting environment for MD iMap with AGS 10.1 in Amazon's cloud environment. After thorough due diligence, the decision was made to keep the physical infrastructure host at Towson University at AGS 10.0.x and to not deploy hosting within Amazon at this time.

Although the time required for making the decision delayed testing on MD iMap and deploying an Amazon hosting environment, there is a positive outcome of the exercise: CGIS has obtained the architecture and related costs for the Amazon hosting environment as developed by an Amazon Systems Architect. Another turn of events that affected the project is the state GIO's decision to redevelop MD iMap-hosted applications to make them mobile compatible, and to deploy OSPREY "lite" (as referenced in Task 6a above) on Maryland's ArcGIS Online (AGO) Premium license.

The circumstances described above also change the project's plan to conduct a workshop to build mobile-compatible AGO applications that would use the basemap/imagery services for real-world testing (Task 5). Therefore, as an alternative, a Cloud-based load testing service is being used that enables *simulation* of real-world user application interaction as part of the environment comparison load testing. In addition, CGIS has invited students in the Towson University Computer Science program to become involved as part of their senior year Capstone project. The students bring a fresh dynamic approach to the research, and their professor is helping to ensure the quality of their work. Their time (match) will help make up for the unanticipated delays, now that the workshop will not be conducted.

Despite the changed circumstances, CGIS will still be able to achieve the core project goals by assessing the cost and performance equivalencies of the Amazon environment with the current MD iMap hosting infrastructure. A formal change request to USGS is in progress that documents the circumstances of the need for the change in project scope and budget.

The changes and status of the project tasks are described below.

Project Tasks, Changes, and Activities

1. Prepare and cache the data in an ArcGIS Server 10.1 compact cache.
 - a. Reprojecting the MD iMap Basemap from Maryland State Plane, meters, to Web Mercator coordinates is complete.
 - i. Note with the real-world application testing no longer feasible, only one cached service is needed. For several reasons the basemap service was chosen over the imagery, primarily because of the shorter timeframe needed to create this cache relative to the compressed schedule.
 - ii. Vector datasets were required for simulated real-world application load testing. Five current MD iMap data sets were chosen and projected for use in testing in this manner.
 - b. The reprojected data has been cached.

2. Deployment of Amazon EC2 ArcGIS server instances at a similar level of server capacity to MD iMap has been completed. Cloud-based scalability to only pay for what is needed at the time based on system load will be tested.
 - a. In order to emulate the server capacity and architecture as closely as possible, an additional Amazon instance is required. With the change in testing methods, the instances do not need to be on all the time. Therefore, this line item cost will be reduced yet still provide the needed additional server instance. This requested change is included with the overall request for award modification.
3. The deployment of Maryland's basemap data and services on the EC2 environment is complete.
4. Test the published CPU equivalencies by Amazon (Virtual core and EC2 compute units) and compare them from a performance perspective with the current MD iMap infrastructure hardware.
 - a. Testing has begun on both the MD iMap infrastructure and on the Amazon infrastructure.
5. The project will not be developing or conducting a workshop to enable participants to create a mobile application due to the change in partner participation and the turn of events described in the project narrative above.
6. *Real-world* use of the system in the Amazon Cloud environment will not be tested due to the change in partner participation described in the project narrative above.
 - a. OSPREY Lite has already been developed at the Maryland Emergency Management Agency (MEMA) in AGO.
7. The project will not be working with MEMA and Maryland DNR to test the data and compare performance due to the change in partner participation and turn of events described in the project narrative above.
8. Publish a white paper that fully documents technical tasks and outcomes, deployment costs, performance characteristics, and the estimated cost of ownership for both environments at the current level of utilization.
 - a. The total cost of ownership analysis and draft documentation is underway.

Next Steps

- Will this project's activities continue after the performance period?
 - Not anticipated at this time.
- Describe the next phase in your project.
 - Complete and document the CPU load testing in both environments.
 - Test and document the spin-up and -down of Amazon on-demand instances.
 - Complete the total cost of ownership analysis; document the analysis.
 - Write the white paper.
 - Complete the final report.
- Requirements (more technical assistance, software, other?)
 - The project is using some of the savings in the cost of the Amazon hosting environment to pay for load testing services from LoadStorm.com.

Expenditures

Due to the delayed initiation of the majority of the system setup and testing until after November 4, 2012, the project expenditure report is current as of last billing cycle of October 31, 2012. The project has expended \$1,567.13 of the award funding. The remaining award balance is \$23,394.99.