Executive Summary

Government agencies using geographic information system (GIS) solutions need an efficient way to share maps with personnel outside the GIS department. GIS application interfaces are complex, requiring extensive training. The maps produced by GIS solutions lack interactive controls that make them most useful, such as panning and zooming, scrolling to see adjacent areas, and adding and subtracting layers. Furthermore, the infrastructure needed to process and store imagery is costly to implement and manage.

Google’s geospatial visualization solutions complement agencies’ existing GIS solutions to overcome these shortcomings. They support agency missions by:

- Giving mobile personnel a familiar interface—Google Earth or Google Maps—to view and update mapping layers
- Accelerating decision-making and project timelines by making new images and metadata available in near real-time
- Lowering infrastructure costs by providing infrastructure as a service (IaaS) to store all or part of the GIS catalog
- Complying with the U.S. federal government’s Cloud First mandate to move three applications to the cloud by March 2013

Geospatial Mapping: Challenges in Federal Government

Sharing geospatial information is a critical component many Department of Defense, intelligence, and civilian agency missions (see sidebar).

Federal Government Use Cases for Geospatial Mapping

- Common operating picture for disaster response, such as location of affected disaster area, displaced citizens, food supplies, and drinking water
- Location of assets such as aircraft or personnel
- Climate data
- Roads and bridges
- Satellite or aerial images of crops
- Disease outbreaks
- Economic data by region

GIS software provides powerful capabilities for analysts. But sharing geospatial intelligence with personnel outside the GIS department has been a struggle, for the following reasons.

Unfamiliar Interface

GIS client software is designed for experts, not employees who use geospatial data in their daily work. Learning to use a complex GIS interface requires formal training, increasing costs and prolonging the time needed for new employees to become fully productive.
Google Visualization Tools for Government Geospatial Intelligence

Static maps lacking interactive controls

The maps that GIS systems produce must be distributed to mobile agency employees on paper or as PDF files. One drawback of static maps is users do not know if the information is current. If the GIS department distributes new maps once a week, employees might be working with information that changed six days ago. Another drawback is that PDF maps generally are not sized for viewing on tablets and smartphones.

Static maps also lack the interactivity that personnel have come to expect. Personnel who rely on geospatial data to make decisions want the ability to drill down; zoom in and out; scroll to see adjacent areas; and turn layers on and off to focus on information pertinent to their role. For example, the map of a disaster area might have two layers—one with aerial photography useful to teams assessing damage, and another with the locations of displaced residents needing food or shelter. Each team would need to be able to view individual layers, as the information pertains to their mission.

Inability to upload data from mobile devices

Legacy GIS applications also cannot directly accept new imagery and data from the field. Instead, personnel provide information to the GIS team to input when they have time. Ideally, personnel monitoring floods for example, could capture video, photos, voice, and text on tablets and smartphones, and then add it to a map layer in near real-time—or at least the next time they synch.

High costs

The high costs of storing the data catalog in the agency data center include:

- Server infrastructure—Processing geospatial data is a compute-intensive task that requires powerful servers.
- Storage: Satellite or aerial imagery requires vast amounts of storage—The same data set may be replicated on multiple servers in the same or different agencies, further increasing storage costs.
- Management—Staff must be assigned to patch server operating systems, keep applications up to date, and back up the data catalog. The use of multiple geographic projections and formats further complicates management.

New Approach: Augmenting Existing GIS System with Cloud-Based Mapping Service

Agencies can increase the value of their on-premises GIS solution by also using Google Maps Engine, a cloud service for visualizing GIS information on maps. Employees already know how to use Google Maps Engine if they’ve used Google Maps or Google Earth. And agencies obtain access to the world’s largest geospatial database, including maps, satellite views, and 45-degree imagery.

Google Maps Engine has three components:

- IaaS to cost-effectively store all or part of the data catalog
- Intuitive tools to create map layers for Google Earth and Google Maps
- The ability for any authorized personnel to upload, search for, and view map layers using the familiar Google Earth or Google Maps interface, using a browser or Android app

Google’s cloud-based visualization service provides several advantages in government (Table 1). Map layers are delivered from the cloud, so authorized agency personnel can access and update information from anywhere, using any device. Processing new inputs to the data catalog is faster, the result of Google’s vast computing resources.

In addition, cloud computing lowers storage costs for the data catalog. Google Maps Engine is provided as a service, so your agency avoids capital costs for hardware and software. You can scale capacity up or down on demand, only paying for what you need. Google takes care of server maintenance, backups, and disaster recovery, reducing ongoing operational costs.
Google Maps Engine provides a familiar interface, making it simple for agency personnel to add, search for, and access imagery and vector and terrain data:

Google Maps Engine has three components:

- Adding authorized users: Your agency's administrator uses a simple web interface to assign permissions to agency personnel. Map users can view information, while map editors can upload new information. Administrators can set permissions for individual maps, making them accessible to entire departments or restricting them to specific groups or individuals.

- Adding new information: Map editors can upload new geospatial data from any device. After logging in, they click the Upload button. Accepted formats include MITAB (MapInfo .TAB) files and Esri shape files. While uploading the file, map editors can add metadata and tags to facilitate searching.

- Viewing map layers: Authorized personnel in the agency or its partner agencies can view up-to-date geospatial information using a web browser, widgets, Web Map Services (WMS), or other agency applications integrated through Google APIs. After logging in, personnel see thumbnails of files they are authorized to view (Figure 1). Selecting an item superimposes it on a Google Earth or Google Maps view. Personnel can zoom, pan, and click to view map layers using the familiar Google Earth and Maps interface.

Table 1  Advantages of Google Maps Engine for Visualizing Geospatial Intelligence

<table>
<thead>
<tr>
<th>Google Maps Engine Feature</th>
<th>Agency Value</th>
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<tbody>
<tr>
<td>Familiar interface</td>
<td>Lowers training costs</td>
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<tr>
<td>Interactive maps</td>
<td>Enables personnel to drill down on map features for more detail</td>
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<tr>
<td>Optimized viewing on different mobile devices</td>
<td>Gives the workforce the flexibility to use any device the agency allows, including smartphones and tablets</td>
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<tr>
<td>Viewing permissions at the file level, for individuals or departments</td>
<td>Meets security requirements; facilitates data sharing among agencies; eliminates the need to integrate files with agency identity systems</td>
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<td>Allows updates by authorized users</td>
<td>Offloads the agency GIS team and avoids delays in updating information</td>
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<td>Integrates with agency applications</td>
<td>Improves productivity by eliminating the need to open a separate interface</td>
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<tr>
<td>Scales to handle usage spikes</td>
<td>Avoids outages when data is most needed, such as disaster response</td>
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<tr>
<td>Securely backs up mapping data to multiple data centers</td>
<td>Supports continuity of operations (COOP)</td>
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<tr>
<td>Can combine of imagery and vector data from multiple agencies</td>
<td>Supports inter-agency collaboration to provide a common operating picture</td>
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<tr>
<td>Offers usage-based billing, by storage and page views</td>
<td>Enables agency to add more users without higher licensing fees</td>
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Familiar User Experience

only the best qualified firms are hired for their public projects,
Google Visualization Tools for Government Geospatial Intelligence

Figure 1 Agency Personnel See a List of All Relevant Maps

Google Geospatial and Mapping Solutions At Work

Google Maps Engine is one of several Google Earth and Maps Enterprise products used in government to make location-aware decisions (Table 2). Following are several examples of the products at work.

Billing

Your agency is billed based on storage and page views. There are no client software licensing costs, and no capital or operational expense for servers and storage.

Table 2  Google Earth and Maps Products for Government

<table>
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<tr>
<th>Google Product</th>
<th>Agency Value</th>
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</table>
| Google Map Engine      | Manage data catalog in the cloud  
Fill in gaps in maps with Google’s Base Map  
Provide access from anywhere with an Internet connection on any device, including tablets and smartphones |
| Google Earth Enterprise| Maintain data catalog on premises, behind firewall; no connection to Google  
Take advantage of support from Google |
| Google Earth Pro       | Use commercial version of free Google Earth  
Intended for smaller geospatial data sets |

Table 2  Google Earth and Maps Products for Government
National Geospatial-Intelligence Agency

NGA uses Google Maps Engine to provide timely, relevant, and accurate geospatial intelligence to a broad range of U.S. federal government departments and agencies. After being authenticated, personnel can access maps appropriate to their role using Google Earth, Google Maps, or Open Geospatial Consortium (OGC) services. Behind the scenes, Google Maps Engine applies Google's vast cloud resources to rapidly process the data, providing geospatial intelligence on-demand to authorized agency users. READ MORE >>>

U.S. Forest Service

USFS firefighters need to coordinate aircraft availability, status, and tracking. Previously, pilots would radio in their positions every 15 minutes to a dispatcher who plotted locations on paper maps. Ground personnel referred to paper topographical maps that they updated with markers and shared by fax. To update a map, personnel submitted a request to the GIS department, which needed 1-7 days to fulfill the information. New papers maps were sometimes out of date before pilots received them.

Now USFS uses Google Earth Enterprise to consolidate data transmitted by GPS devices on its own airplanes as well as contracted airplanes, and displays their real-time location in Google Earth. Other relevant GIS data created with a GIS tool can also be imported into the system, including shape files of temporary flight restrictions from the Federal Aviation Administration. The USFS conservatively estimates that a mere .5% improvement in the operational effectiveness of its own aircraft translates to $875,000 in annual savings. READ MORE >>>

Air Force Weather Agency

AFWA needs to synchronize weather data from around the world for pilots heading out on missions. Previously, the agency and operational weather squadrons relied on multiple websites and technology products, each focused on a different region. Pilots were provided static maps built from 800,000 images, and could not pan, zoom, or drill down.

Now, with Google Earth Enterprise, weather forecasters can overlay the Air Force’s own satellite and radar shots over a background map, with one viewer and two clicks. Preparing briefing information before flight missions before takeoff takes less than 10 minutes, less than half the time it did before. READ MORE >>>

Virtual Alabama

For the state of Alabama, preparing a disaster declaration previously took days or weeks. Then the state developed a program called Virtual Alabama, built on Google Earth Enterprise, to provide a common operating picture for personnel involved in disaster response. A plane is dispatched to capture aerial photography as soon as it’s safe, and the images become available to government decision-makers the next day. The state populates its maps with gas lines, water lines, flood planes, fire hydrants, and more. Conceived of for homeland security and emergency management, Virtual Alabama is now also used for economic development, environmental management, and conservation of natural resources. READ MORE >>>

Conclusion

Storing, managing, and sharing your geospatial intelligence to the cloud with Google’s geospatial visualization solutions solves several government mandates:

- Empowers the workforce to be fully productive sooner, by providing a familiar interface with interactive controls
- Provides more current information on which to base decisions
- Lowers infrastructure costs associated with the data catalog
- Satisfies the requirements of the Cloud First initiative

For More Information

To discuss use cases for your agency and obtain pricing, email DLT Solutions at google-solutions@dlt.com or visit www.dlt.com/google