Extending a Defense Computing Cloud to Warfighters at the Edge

Thermopylae Sciences and Technology

Abstract
The Department of Defense (DoD) has historically adopted innovation from the commercial tech sector to build a stronger military, increase efficiencies, reduce layers, and achieve a technologic advantage over adversaries. Two emerging technologies that the DoD is currently working to integrate are cloud computing and mobile smart phones. These technologies address a capability gap that is a common denominator between commercial and DoD missions. The commercial sector carries the bulk of development costs on this technology, which will provide sustained innovation in spite of planned defense spending cuts. With a vast array of Intelligence, Surveillance, and Reconnaissance (ISR) sensors the Intelligence Community is well suited to benefit from secure cloud computing capabilities. With the potential for smart phones connecting in to DoD clouds there is a growing consumer base for data that was not previously accessible.

Two categories of DoD cloud computing initiatives are commercial clouds provisioned for DoD use that reside in commercial company data centers and private clouds that are wholly owned, managed, and housed by the DoD. The ability to feed the demand for geospatial data through a real time operational system is enhanced by both of these variants. The mobile smart phone is emerging as the forward deployed edge of the DoD computing architecture and how to extend cloud data to this edge of the DoD network is an increasingly important topic. Current challenges center on how data in the cloud is extended to the edge and how data at that edge is pushed back into the cloud.

Two emerging software tools are being used throughout DoD to enable greater situational awareness of information in the cloud via web based geospatial interfaces and mobile devices. One tool, called iSpatial, correlates imagery and data and feeds them to a common web site, so that users carrying mobile devices or seated at web browsers can view a common situational picture. The second software, called Ubiquity, lets users go online to assemble widgets into “apps” that can be loaded onto Android or iPhone devices.

Keywords: Ubiquity, iSpatial, Haiti relief efforts, National Geospatial Agency, USSOUTHCOM, mobile applications, DARPA, iPhone®, Android™, US Army G2

1. INTRODUCTION

The unclassified requirements to support missions such as Humanitarian Assistance and Disaster Relief prompted the National Geospatial Agency (NGA) to look for ways to expose their products to a wider user community while leveraging cost saving cloud computing to manage this data. Google Earth was selected as a commonly known tool for exposing the imagery, maps, vector, and terrain data to users and NGA contracted directly with Google to use their cloud for managing NGA unclassified data. The Google cloud provides NGA an environment where thousands of processing cores can be turned on or off to support changing mission requirements. This program called Longview uses Google's recently released Earth Builder software. As a result, this avoids significant infrastructure procurement and sustainment costs for NGA.

The Google Earth Globe is commonly recognized by many but the technology to build it and keep it up to date is not as widely understood. Imagery, vector, and terrain data is fused to the Google Earth Globe through a process called fusion. Having access to a cloud of servers for this fusion process allows imagery to be updated very quickly and presented to users. During relief efforts in response to the 2010 Haiti earthquake, the DoD command for the Caribbean and Central/South America (US Southern Command or SOUTHCOM) ran their Google Earth Server in collaboration with the US Department of State in order to rapidly fuse imagery and make it available to relief personnel. Thermopylae Sciences and Technology (TST) was involved with this effort and integrated the iSpatial and Ubiquity software to make geospatial data available ubiquitously on web and mobile devices. Imagery updates occurred every 4-12 hours, which provided a canvass for visualizing other relief data. Military personnel were able to have shared situational awareness of their intelligence and operations data, as it changed in near-real-time on top of the recent imagery in their web based Google Earth display.

Figure 1 – 3D User Defined Operating Picture

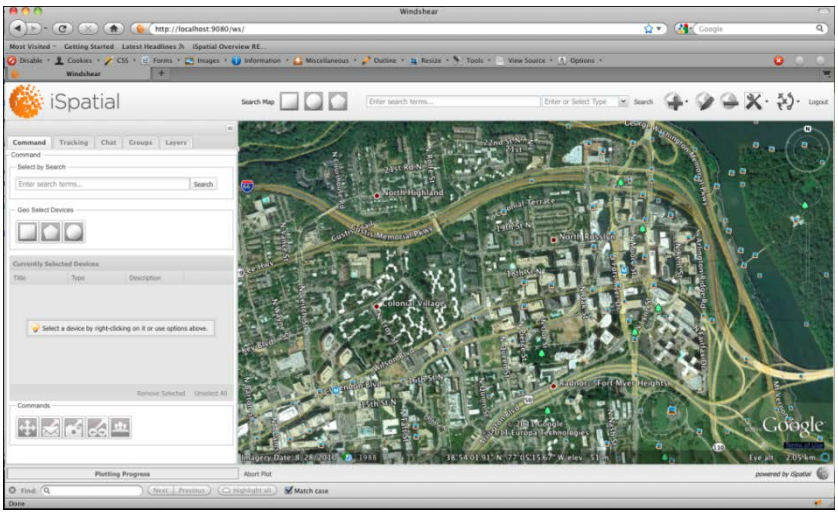
2. iSPATIAL

iSpatial is a solution that organizations like SOUTHCOM, Dept. of State, and Army G2 are using to manage their geospatial data on top of maps, imagery, and Augmented Reality. iSpatial manages geospatial data on the server side but also in the web browser that faces the user. On the user facing side, it provides a wrapper around the Google Earth web plug-in. That wrapper contains standard tools like those you would find in the Google Earth desktop software but makes them available on a web page combined with the Google Earth or Maps web interface. iSpatial was also designed to handle data that changes rapidly or that a user wants to edit, such as the location of friendly/Blue forces or the status of a bridge that troops plan to utilize. This allows any user to have access to the latest imagery and maps provided through an intuitive interface like Google Earth while viewing their organizational data and interacting with it.

Figure 2 – iSpatial Fusing Aerial Imagery with Ground Based Imagery

On the back end iSpatial indexes geo data, stores it in a cloud computing environment and allows users to leave their network connections that tie them to the cloud and take a subset of their data with them on their laptop, local server, or mobile device. This gives a user the same interface for managing their spatial data when they are disconnected from the network as when they are connected. An example of this is a Soldier deploying to Haiti to help with the disaster relief efforts. They can go to a web page that has Google Earth and iSpatial, draw a polygon around Port au' Prince, and export all of the imagery and associated data that their organization has on that area. That data can be dropped on their laptop and they can view it, add data to it, or search it for information while they are disconnected from the network.

Figure 3 – iSpatial as a Web Page With Google Earth Web Plug-in



Organizations like Army G2 have recognized the need for enhancing edge networks and programs like Land ISRnet holistically look at optimizing network capacity in tactical environments. This includes secure 3G cellular support that will connect cloud computing power to mobile smart phones. Web based tools for accessing and visualizing DoD data have become more prevalent in the last 5 years. The commercial sector's wide use of web based interfaces and a departure from stand-alone software on a desktop has provided an opportunity to access cloud data in simple ways. At the same time, mobile smart phones have embedded themselves in the personal lives of DoD service members and warfighters at the tip of the spear. The demand within DoD to have mobile devices serve as a secure end point increases as these warfighters grow more proficient with the advanced technology smart phones provide. The desire for accessing information via smart phones will only grow as new generations of users join the active duty military force.

Figure 4 – iSpatial Managing Geospatial Content Over Google Earth Web Plug-in

When the mobile user is connected to a cloud it enables them to fill a meaningful role as an intelligence producer and maintain situational awareness. Incidents like the fratricide that occurred in Afghanistan's Sangin River Valley on April 6, 2011 are constant reminders that

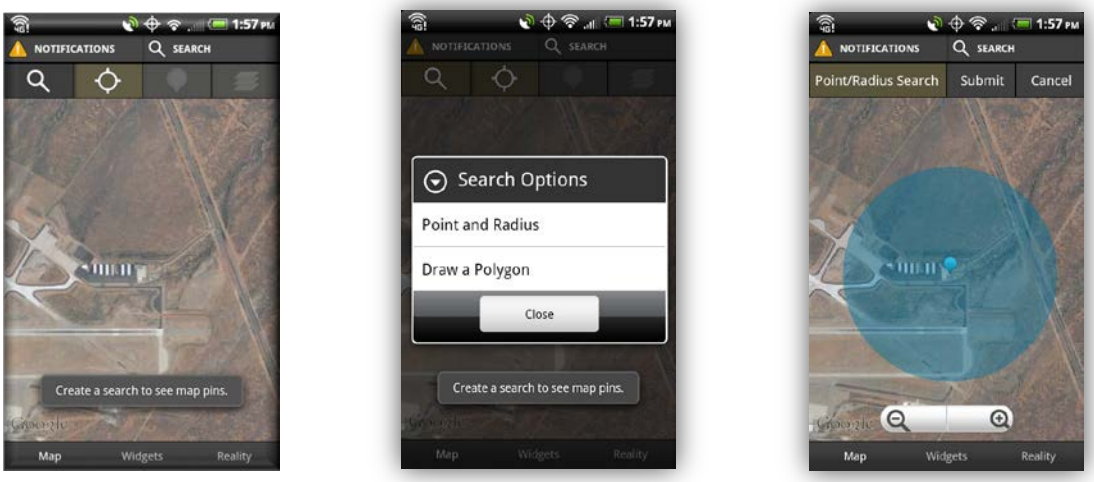
innovative technologies are imperative to support the warfighter. In this example, precious time was lost as intelligence coordinators scrambled to recreate the situation on the ground in 3D tools like Google Earth to assess whether or not the target was a friendly. The plethora of features on a smart phone turns every user into a smart sensor that can share their information in real-time. Programs like Windshear seen at Empire Challenge of 2011 already fuse mobile data directly in Google Earth through Ubiquity software in order to provide the most intuitive virtual recreation of the battlespace in the shortest time possible. Taking full advantage of a mobile user base in a coordinated fashion requires various activities such as collection management, mobile application management, and security management.

Figure 5 – iSpatial Managing Simulated Mission Planning Data

3. UBIQUTY SOFTWARE APPLIED

Through Windshear the Army G2 uses Ubiquity as a mobile application service framework for corralling the smart phone space. The Ubiquity product is being used as the framework for extending the cloud to smart phones on this program. Commercial corporations in the Energy, Sports, and Telecom industry are using Ubiquity to be more competitive, save money, and innovate in how they do business. DoD is in the same situation and the rapid technology disruption that has occurred with smart phones has forced system of system portfolio planners to think about how to leverage tools like Ubiquity in their programs.

Figure 6 – Ubiquity Widgets Used on Windshear



Ubiquity provides an end point that installs as an application on an iPhone or Android device. It has various widgets that are pushed to the smart phone based on the context that the user finds themselves in. A context is merely a collection of widgets that interoperate with each other and can be determined by the geospatial location of the device or by the activity the user is performing on the device. Ubiquity was designed around the concept that no plan in the battlefield survives the first point of impact, so new contexts can be pushed to users that find their mission changing. Ubiquity supports workflow management on Androids/iPhones and can connect to other mobile applications that were built outside of Ubiquity, so that the user has a seamless experience if they need to perform a function on another mobile application. This provides the ability to make changes to the tools a mobile device has without having to download an entirely new software application to the phone. The data exchange between a cloud computing environment is coordinated through the Ubiquity software and passing imagery from a Google Map or Earth server directly to a mobile Google Map is an example of the internal technical infrastructure Ubiquity provides.

Ubiquity allows users to configure the contexts that will show up on their mobile device before leaving their office, tactical operations center, or base. The users can go to a web based user interface that shows them a picture of their iPhone or Android and allows them to drag and drop widgets onto the device. They can even customize the look and feel with organization logos, pictures, and names. Users can point their widgets to different cloud based services in order to reach back out to them when they are mobile. Once the app has the right widget functionality, look and feel, and data connections the user presses a button to publish their app and it is available within 5-10 minutes for download from their organizations enterprise Ubiquity app store or from a public marketplace. This management system provides DoD users like SOUTHCOM and Army G2 a secure container foundation to start from in the mobile space. If a widget isn't available in Ubiquity there is a downloadable SDK that allows 3rd parties to create widgets of their own while leveraging existing infrastructure components of the framework like augmented reality services or alert management. This innovative approach to mobile applications empowers the user to tailor their experience without compromising data integrity or security.

Figure 7 – Ubiquity Widgets Dashboard on Mobile Device

Ubiquity widgets like Augmented Reality that visualize everything from locations of other friendly forces to ground based images that were taken with other mobile devices provide a unique tie back to geospatial cloud data. Augmented reality is an example of how the mobile spatial environment differs from a traditional geospatial experience. When operating on a mobile device spatial data has an increased relevance over a traditional interaction with the same data. Think of the last time you pulled up Google Maps on your smart phone to get directions when you were lost in an unfamiliar city and you understand this concept. Google Earth/Maps has been adopted by DoD organizations from NGA to SOUTHCOM for geospatial display of data.

4. CONCLUSION

The power of cloud computing now allows for more imagery, maps, geospatial data, and other mission critical information to be stored, searched, and visualized than ever before in the history of computing. The cloud must be able to extend the data it has to the network's furthest edge and collect data back from that edge in order to achieve its full potential. DoD programs are making this happen by leveraging a combination of commercial and government technology today. Tools like iSpatial and Google Earth are operational across classified and unclassified DoD networks and changing the way we do business. New mobile capabilities through Android Operating Systems and Ubiquity mobile framework implementations are coming on-line through programs like Windshear and pushing the edge of information dominance to the warfighter at the tip of the spear.