Discover: Utah's Base Map & Imagery Services

Category · 2018 Data Management, Analytics, and Visualization

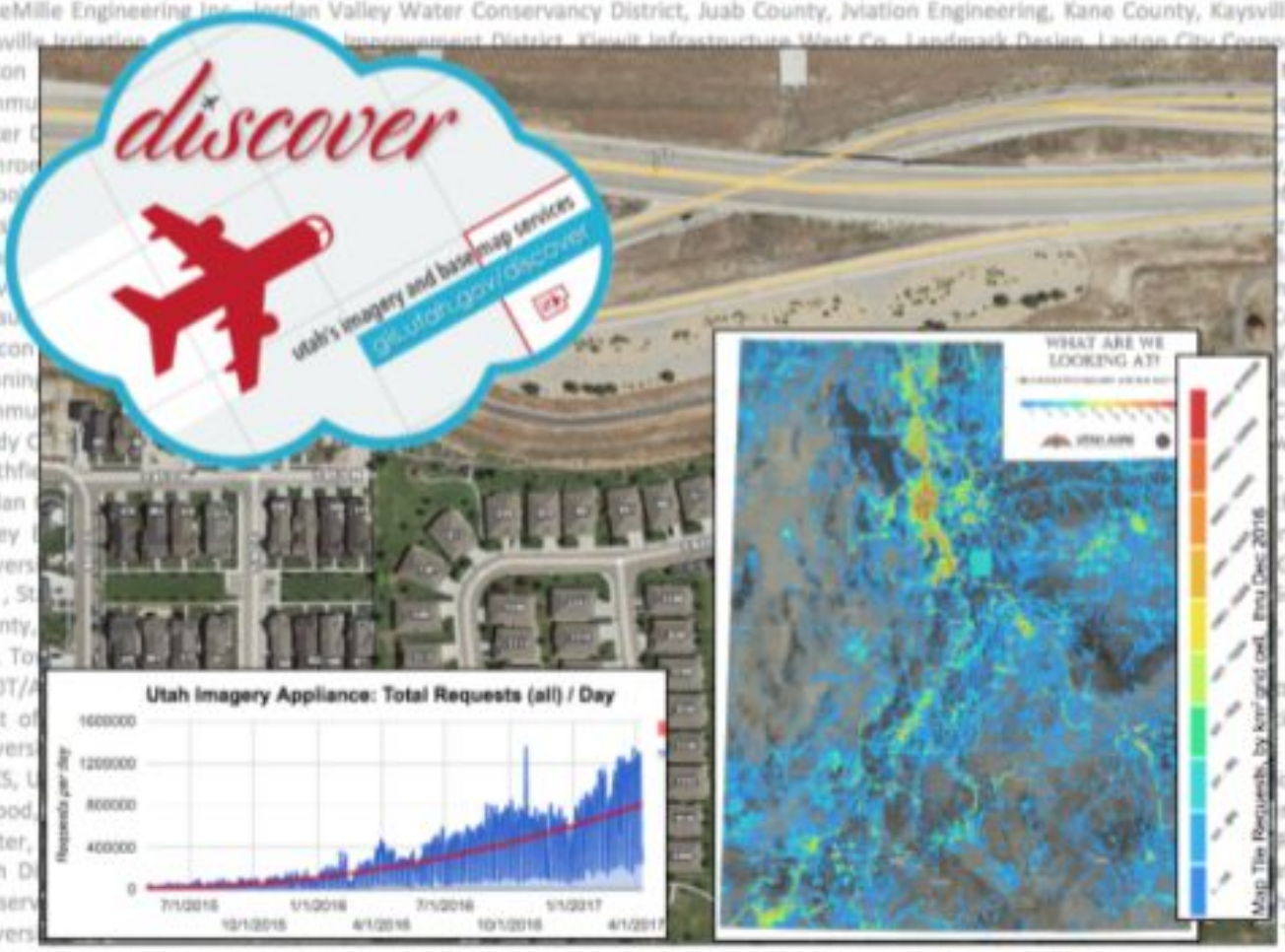
Project initiation and completion date -- May 2015 - Dec 2016

Organization and primary point of contact --

Organization(s): Utah Department of Technology Services
Automated Geographic Reference Center (AGRC)

Contact: Matt Peters, mpeters@utah.gov

Project Website: http://gis.utah.gov/discover



[Organizations Using Discover Services]

Summary

In May 2015 the State of Utah's geographic information office, the Automated Geographic Reference Center (AGRC) launched Utah's Discover Base Map and Imagery Services (DISCOVER). The state-of-the-art, scalable, cloud-based DISCOVER web service platform was built originally to meet requirements for storing, and providing access to the statewide high resolution aerial photography (6" pixels) that is licensed to Utah from Google and funded through a partnership across 14 state and local agencies.

The funding coalition for the Google imagery license, known as the Utah Mapping and Information Partnership (UMIP), established a vision for this initiative to address the strategic importance of enterprise map data content served to all creators and users of spatial data, and analytics and sought advantages from a shared delivery platform:

> *Utah's public entities and their partners, will realize significant efficiency gains from a shared statewide platform that offers all users the same set of highest-quality mapping data, while avoiding duplicative costs, across organizations, for the required system design, storage, delivery platform, and associated operational expertise.*

At the onset of this project, the high resolution aerial imagery licensed from Google required over 12 TB of data storage, over 20 times more than the next largest Utah map data asset. The size of this dataset and the expected scaling needs of the web service delivery platform necessitated a hosting solution in the public cloud. Since launch, an additional 20 layers of non-licensed base maps and vintage aerial photography have been added to DISCOVER for use in GIS, CAD or browser-based interactive maps.

In addition to the 14 funding organizations, over 350 organizations have requested and received access to the DISCOVER platform. DISCOVER, utilizes the AppGeo Giza Tile Serving Appliance to deliver the licensed and unlicensed content to public sector agencies and their contractors/partners. DISCOVER tracks usage by entity, layer, service, and -- most importantly -- by geography. *This detailed usage information from DISCOVER is expected to be critical to the UMIP partnership as it makes the case to explore options to acquire updated aerial photography from Google or other vendors.*

The map resources delivered by DISCOVER are used in a variety of web and desktop applications to solve pressing issues (elections, transportation, natural resources, 911/emergency response, economic development, property records, etc.) by providing geographical context at statewide and local scales while adhering to the provider's terms of service.

Project Narrative

Concept

While rarely acknowledged, the GIS field has been providing leadership for over a decade on today's increasingly prevalent 'open data' concepts. The GIS data sharing paradigm, back in the 1990's and 2000's, was not fueled by altruism or principle, but, rather, by the basic fact that it is neither practical nor cost-effective for anyone to use GIS and other spatial data in isolation. Given the pure size and versatility of spatial datasets, strong shared data resources are just flat out needed in order to be successful with map technology. Indeed, the government geospatial credo has been "create once, use many times." Geographic data can and should be 'open' where appropriate and practical, but consideration also needs to be given to 'hybrid' models that align with new private sector data offerings that provide affordable, data licensing models to government.

Ten years ago, the National States Geographic Information Council (NSGIC) developed an idea called Imagery for the Nation (IFTN) and advocated for a coordinated national aerial photography program to ensure accessibility to aerial imagery, with a periodic refresh schedule. Aerial photography is an essential contextual resource, and while the IFTN concept has languished at the federal level for higher resolution products, new licensed imagery programs - now from several vendors - seem poised to deliver on the IFTN enterprise vision, through a focus on public-private partnership. DISCOVER, in terms of deployment, cost, and utilization, proves out the IFTN concept at a state level for high resolution imagery,

The conceptual design behind the high resolution aerial photography and DISCOVER server project was relatively straightforward:

- Build a funding partnership among like-interest agencies, with a goal of obtaining high resolution imagery providing a similar quality resource for all rural areas. Previously, the highest resolution imagery was only acquired for Utah's most urban areas (3% of the state).
- Acquire an enterprise data content asset, available to all of Utah's public sector users of map technology, that aligns with prominent private sector licensed offerings. This approach allows UT to acquire the imagery at 10% - 20% of the cost of a comparable public sector procurement.
- Leverage the cost efficiency and scalability of the public cloud, which is also 10%-20% of the cost of comparable internally-hosted solutions.
- Provide a web service connection point that provides users to access just the information they need, offering performance as if the data resource is onsite, and tracking valuable usage metrics to support return on investment (ROI) calculations and informs future investment decisions.

Significance

Geographic Information Systems (GIS) and related spatial platforms (CAD, 911 dispatch, interactive web maps, etc.) leverage locational information as a methodology for integrating vast amounts of disparate, but mission critical data. Location, in many ways, has become the greatest common factor by which information can be integrated in a cost and time-efficient manner. We the value of geospatial in common operating pictures, citizen engagement sites, and other decision support systems and models that have made inroads in almost every sector and level of government.

A common refrain in GIS and other spatially related endeavors, is the desire 'to get everyone on the same map' to both increase data quality and also the efficiency of work outcomes that benefit from map information and analyses. And of course, that 'same map' should be precise and up-to-date. Thus, the best ROI for improving map data is provided by coordinating with, and connecting to the best mapping resources being created by others.

The UMIP partnership was formed initially to explore the use of GIS to share information between the Departments of Natural Resources, Transportation, and Environmental Quality to tackle interrelated issues in the Uintah Basin, Utah's major oil and gas field region. The UMIP leadership pursued an opportunity to license Google's high resolution imagery for this area, but quickly expanded the scope to the entire state when the large price advantages became apparent. The state was able to purchase an imagery license that extended use rights to all county, city, and tribal governments and their formal partners and contractors. *Everyone* could use the same high quality data while acquiring use rights at a fraction of the cost by aligning with Google's existing program that also delivers imagery updates to its public Google Maps and Earth products.

Impact

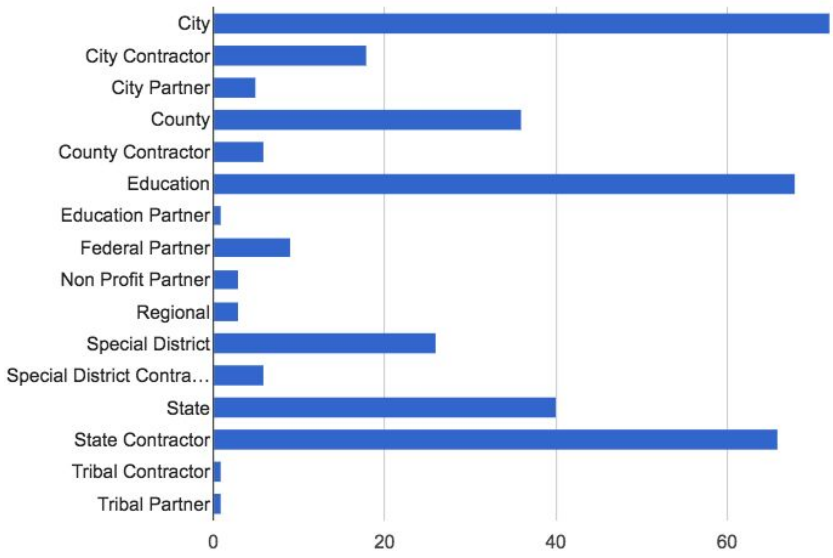
This UMIP-led initiative successfully provided access to high resolution aerial imagery while meeting the following requirements:

- ***Economically store and provision terabytes of large aerial photography, and later, pre-rendered base map services that leverage state and local data assets:***

Each layer on DISCOVER consists of a pyramid of pre-rendered 256 x 256 pixel map tile files, for each of 20 scale levels (from 1:600,000,000 down to 1:1,100). This vast collection of map tiles as well as original imagery files (now, over 40 TB) are stored in Google Cloud Platform buckets (at a cost of $26/TB/month), and tile requests from all users/application are validated, logged, and delivered in milliseconds using the Giza tile server platform adapted from open source, by Applied Geographics, Inc.

- ***Engage and onboard hundreds of stakeholders across multiple sectors to build usage, adhere to terms of service, and avoid duplication of effort/expense:***

To access the DISCOVER services, each organization must complete an online form that gathers agency contact information, anticipated uses, and an acknowledgement of allowed terms of service. Since launch in May 2015, AGRC has steadily grown the user base for DISCOVER to over *300 Utah organizations* including higher education and state, local, and tribal government agencies, and their contractors and partners.



The innovative 'quad word key' authentication built into DISCOVER's core Giza map service software allows licensed content to be delivered to those qualified to use it, and makes the public domain content available to other non public sector organizations (i.e., a single cloud-based serving platform provides access to both licensed and public data sets).

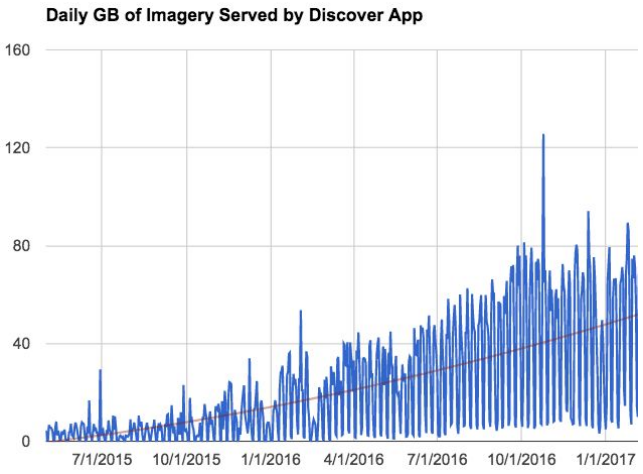
- ***Ensure services provide a quality user experience, including authentication for licensed map layers:***

In 2016, AGRC added over 20 non-licensed base maps and vintage aerial photography layers to DISCOVER that can be incorporated into GIS and CAD projects via Open Geospatial Consortium (OGC) WMS and WMTS standard web services. These services can be called directly by thin client interactive web maps using http protocol as well as powerful desktop GIS and CAD software packages.

- ***Track utilization of imagery and base map services to measure service quality and prepare business case for funding of future aerial photography updates***

An outstanding benefit of DISCOVER's Giza-based platform is that AGRC now has access to multi-dimensional usage statistics (as summary queries or in real time), including the ability to view use by organization, web application, service type, time period, and view scale/geographic area as a heat map (see graphic on cover page). Usage data is recorded by

placing every service request into Google BigQuery (i.e., Google's "big data as service" offering) creating a storehouse of every user interaction with DISCOVER. Currently, the usage storehouse contains more than 240,000,000 total transactions.



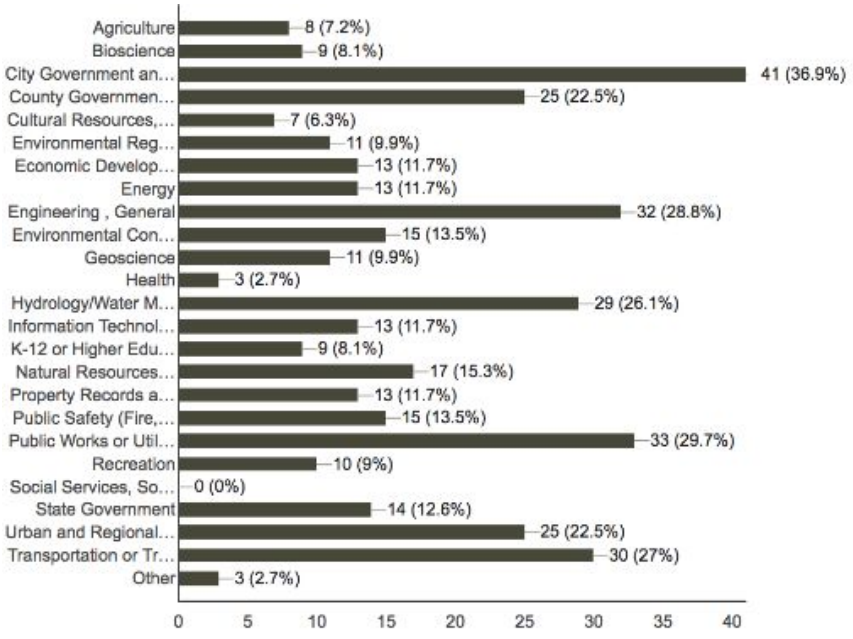
The pre-existing model for base map and imagery data delivery focused on providing public domain map data resources via anonymous ftp or web service usage and provided only request count and throughput totals. Now, the AGRC can look at exactly where in the state the services are being used in a way that clarifies where the 6 inch resolution imagery is being used to reveal details that are not visible with the previous public domain one meter imagery.

Usage of the Discover services was already robust and user feedback was quite positive at the beginning of 2016, and by the end of 2016, overall usage had increased over three times in the space of those 12 months. (see graph at top left).

Last, since web map applications are each assigned their own DISCOVER API quad word authentication key, detailed geographic usage information is now available for any of the state's or partner's premier mapping applications that use DISCOVER such as locate.utah.gov, parcels.utah.gov, wri.utah.gov, atlas.utah.gov & crashmapping.utah.gov.

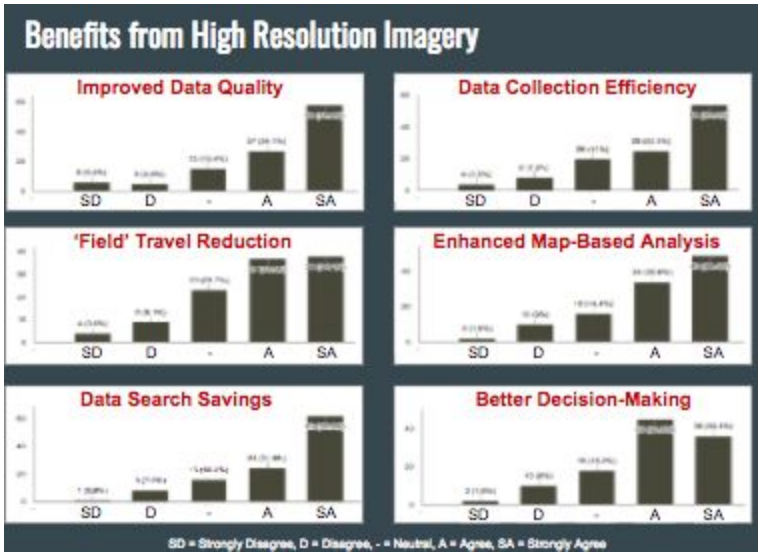
- ***Gathered user experience feedback & assessed ROI via usage survey:***

Since the DISCOVER launch, AGRC has continually sought to engage and support users by gathering feedback and utilization metrics. These efforts have included use of AGRC's email newsletter (over 1,500 subscribers), website (gis.utah.gov), and also a Town Hall Meeting (December 2015). Additionally, over 110 organizations responded to a voluntary user survey (Spring 2016) which confirmed DISCOVER's performance and the value of DISCOVER services in



terms of return on investment. Over 80% of respondents gave the service an 8 out of 10 rating or higher for both performance and value.

From the survey results (see graph on previous page, lower left), it is clear that the DISCOVER platform is having a positive impact in many critical state priority areas that include: agriculture, economic development,, environmental quality, energy, health, education, natural resources, public safety, public works, and transportation.



Beneficial impacts (reported at right from strongly disagree to strongly agree) include:

- improving spatial and other data quality,
- field work reduction and preparation,
- enhanced map analysis and location validation, and
- improved decision support.

Impact Summary

The Discover Base Map and Imagery Services implementation represents an innovative best practice for its IT platform, it's delivery of valued content, and as a coordinated, enterprise solution. Critical geographic information required across the public sector, ultimately fueling additional data sharing, integration, and efficiencies by:

- Providing high performance, high availability access to high quality aerial imagery and basemaps via web services to over 700 daily users across 300+ agencies in higher education and state, county, local and tribal governments.

- Utilizing the public cloud to be cost effective with *> 40TB of data storage* and a scalable cluster of *5 dedicated servers for less than $40,000* per year in operating expenses.

- Leveraging both the newly emerging private sector licensed data market and the expertise and knowledge of data stewarded by local government to bring higher quality statewide imagery and basemaps to Utah, with cost savings of 80% compared to traditional imagery and IT platform approaches.

- Providing the AGRC and UMIP partners with valuable user and data metrics through big data analysis that document ROI and inform future investment decisions.