HEXAGON | US FEDERAL

CLOUD-BASED GEOSPATIAL EXPLOITATION SOLUTION

A CASE FOR THE CLOUD

White Paper
April 2015

1 Introduction

The demand for cloud-based solutions continues to increase across the U.S. federal government, private industry, and consumer IT markets. Historically, many organizations have faced challenges associated with deploying desktop-based software on individual devices across an enterprise. These issues include complexity in managing and monitoring desktop software usage, slow upgrade cycles, lack of flexibility in meeting increased demand or supporting mobile users, and high maintenance and support costs. These organizations already know cloud-based solutions provide benefits such as streamlined and reliable software management processes, more frequent technology update cycles, robust support for remote and mobile users, and reduced maintenance and support costs.

From the standpoint of a U.S. Federal government organization providing uninterrupted services to internal users, mission partners, or the general public, additional benefits to cloud-based services include failover, redundancy, and load balancing for changing demand cycles. From an end user's standpoint, the advantages include ubiquitous access from virtually any location and any device (e.g. PC, laptop, tablet), less disruption due to software upgrades, and secure backup copies of important data and documents.

The U.S. Federal government has embarked on a number of sweeping moves to the cloud across federal civilian, defense, and intelligence community agencies. For example, in 2012, the U.S. Intelligence Community (IC) Chief Information Officer (CIO) embarked on the largest IT transformation in IC history, called the Intelligence Community Information Technology Enterprise (**IC ITE**). The initiative focuses on enabling greater integration, information sharing, and information safeguarding through a common IC IT approach that substantially reduces costs. Additional examples include **GovCloud** and **C2S**. GovCloud allows U.S. government agencies and customers to move sensitive processes and data into the cloud by addressing their specific regulatory and compliance requirements. C2S, an Amazon-built private cloud, allows intelligence agencies to order a variety of pay-as-they-go computing services.

The growing popularity of cloud versions of mainstream products is indicative of an irreversible trend. Cloud-based solutions such as Google Apps, Salesforce.com, Office 365, and Adobe Creative Cloud are evidence of this. A few of these examples represent solutions born in the cloud (completely web-based from inception), while others, such as the Office and Adobe solutions, represent a business and technology shift away from physical machine-based perpetual licensed software to a user-based subscription licensing model also called Software as a Service (SaaS).

In Microsoft's example, in the past, users or organizations would purchase discs with Microsoft Office software (Word, Excel, PowerPoint, etc.) and install it on a laptop or desktop computer. With the cloud-based model, users now pay online for a subscription to the Office 365 service and then download selected modules to their computing devices. As an incentive, the storage and management on a remote server of user data is an integral part of cloud-based subscriptions.

Physical digital media itself is no longer in high demand, as exhibited by the trend toward purchasing only digital copies of music, TV shows, and movies. The days of walking into a "brick and mortar" store and purchasing a perpetually licensed copy of a software application are coming to a close.

Cloud-based solutions are also being adopted throughout the geospatial industry. Client-server and web-based access to mapping and navigation applications has been a mainstay for well over a decade and represent in part a move away from desktop software. Many government agencies provide outward-facing web services to mission partners or the general public for downloading maps and imagery. In some cases, basic analysis and processing capabilities are freely available. However, many client-server solutions that provide simple viewing and analysis, such as Google Earth, are limited in their ability to support the wide range of geospatial functions that many organizations require. Furthermore, they often do not provide the level of accuracy required. In this case, the move to the cloud takes web-based access one step further by providing substantial improvements in performance, accessibility, accuracy, and reliability not only to those outward-facing services, but also to a wide range of internal geospatial applications and processes.

A key challenge facing the geospatial community in particular has always been dealing with the large amounts of geospatial data being managed and accessed, especially remote sensing data such as satellite imagery, aerial photography, LiDAR, and radar. As more and more ground-based, airborne, and orbital sensors are deployed and dataset resolutions grow with increasing speed, the industry must address data security, discovery, access, and performance as an integral part of any cloud-based geospatial solution.

Geospatial applications have typically held the stigma of being very costly, isolated, or "stovepiped," and complex, often requiring specialized training for users to become proficient. With growing amounts of geospatial data driving new and exciting applications of geospatial technology, improved battery life and computing power on mobile devices, and continually improving network availability and bandwidth, the possibilities for the geospatial community with regard to harnessing the power of the cloud to make monumental contributions in new areas is very real and exciting. In order for this idea to truly take flight, the industry cannot move forward relying on deploying the same complex geospatial applications from a cloud server in a SaaS manner.

2 Virtualization Is Not the Answer

Virtualization is essentially a way to provide users access to a software application on a remote server instead of their local machines. Processing and data access are handled by the remote server, and the display/mouse/keyboard interaction occurs on a more traditional computer. In many cases, the application is the same one that users already had installed on their local machines. While the pure SaaS model does provide some cost advantages from an IT maintenance and management perspective, it can substantially drain network resources and will not work in disconnected user environments. Sometimes no savings are realized in training or even software licensing costs. Furthermore, virtualization perpetuates another problem—if the application was difficult to use previously, it is still difficult to use, and it may now be more so because the processor is remote.

The answer to improving SaaS in a cloud deployment involves building more lightweight, intuitive, mission-specific applications. For geospatial applications, this can be accomplished by decomposing heavyweight geospatial software into useful stand-alone functional elements that can be reassembled into more streamlined applications. The user experience is improved, training costs are reduced, and the result consumes fewer computing resources and less network bandwidth.

3 On Open Standards

Open standards are critical for improved geospatial collaboration within and across organizations today because they offer vendor-neutral methods for sharing data between diverse systems and applications. System architectures based on open standards support a model where technology refreshes happen frequently and reliably, essentially enabling an organization to innovate and "evolve" at a rapid pace. Hexagon US Federal is a founding member of the Open Geospatial Consortium (OGC) and produces the largest collection of open standards-based geospatial products of any company in the world. Our Hexagon and ERDAS product lines undergo development with open standards and place sharing as a key focus, so open standards support is essentially embedded within the product's DNA rather than included as an afterthought.

A key aspect of open standards-based geospatial solutions has always included open data sharing. The initial focus on OGC standards was on open geospatial data formats such as Web Mapping Service (WMS) and Web Feature Service (WFS) that allow for vendor-neutral serving and sharing of data. These standards have evolved to now also include server-based execution of geospatial processes via OGC Web Processing Services (WPS) and the more modern, versatile protocol Representational State Transfer (REST), or RESTful, services. These web services allow for a remote user to discover remote geospatial processes, link them to data sources, execute the remote process, and then exploit the results. As a core feature of the Hexagon cloud-based solution, users can create these geospatial services directly from a cloud-based authoring tool and publish them to be available as RESTful services.

4 Geospatial as an Infrastructure

Geospatial solutions have evolved over the past few decades from a rarefied science to a useful industrial technology, and geospatial awareness is now being considered integral to the IT infrastructure for many enterprises. Instead of geospatial solutions being a specialty application that requires high-end computing devices, advanced technical knowledge, and large amounts of training, it is an enabler that now seamlessly integrates into our daily professional and personal experiences in many beneficial ways.

Geospatial processing is widely accessible to the broad population via a plethora of devices and methods. This is evidenced by the fact that geospatially aware technologies are such an innate and essential part of our modern lives, like running water or the Internet, that these services are becoming more reliable and ever-present. The GPS technology that is in our cars, on our smart phones, and embedded in our watches represents this state. Geospatial integration with social media is also a key example of how ingrained geospatial data is in our everyday lives. For example, Foursquare, a location-based service, lets people leave 'tips' (or notes) at participating locations for their friends or for other people that may show up later. If you visit a restaurant, you can leave a specific tip using Foursquare such as what you thought about a specific entrée, "in the cloud." Then, when other subscribers show up and check in, their Foursquare-enabled smartphones pull those tips out of the cloud for viewing. This occurs effortlessly and elegantly, with no thought at all by the user given to any geospatial aspect. Within a federal government organization's IT enterprise, the Hexagon cloud-based exploitation solution moves high-end geospatial processing and analysis from a desktop-constrained technology to an infrastructure. This enhances daily operations and improves mission effectiveness by making the geospatial processes more readily accessible and intuitive to operate in a manner that seamlessly integrates these geospatial processes into the fabric of the organization.

5 A Strong Foundation for the Future

Similar to Adobe and Microsoft, Hexagon, and its parent company Hexagon, have embarked on a paradigm shift away from a desktop-centric model to a cloud-based model for geospatial processing. We have been building on our strong legacy in the GIS and remote sensing field with flagship products like ERDAS IMAGINE®, ERDAS APOLLO and GeoMedia to achieve this goal. These product families have been on the market for decades and have developed a loyal and productive global user base. They are currently in use across a number of U.S. Federal organizations spanning the civilian, defense, and intelligence agencies, and include support for classified requirements. These geospatial product families form the technical foundation of our cloud-based exploitation services in the following manner:

- **GeoMedia and ERDAS IMAGINE** provide the collection of foundational geospatial technology for performing an extensive range of geospatial processes, such as image and terrain processing, photogrammetry, GIS and vector analysis, and map production. A wide array of geospatial and other data formats, coordinate system conversions, and algorithms are available.
- **ERDAS APOLLO** is the current server product that provides a wide range of comprehensive geospatial data management and delivery capability, including the fastest image server available on the market. In the new architecture, APOLLO-based services will form the "geospatial services engine" which serves as the central switchboard that links users across the enterprise with a wide variety of geospatial services to execute with data in a variety of formats. APOLLO includes robust support for cataloging, searching, and delivering vast amounts of geospatial data in a variety of formats, including aerial photography, satellite imagery, radar, LiDAR, terrain, vector, and geospatially tagged data.
- **Spatial Modeler**, which is currently a part of ERDAS IMAGINE Professional and soon to be in GeoMedia Professional, serves as the authoring environment for assembling operators (functional elements) into geoprocessing chains (referred to as Spatial Models) that support a wide variety of workflows. Spatial models run as a self-contained process that typically executes functions on input data and generates results. Models may be executed within ERDAS IMAGINE and also published to the cloud as REST services. By publishing them to the cloud, other individuals and systems across the enterprise gain access to them and can execute them in the cloud. The services can be run stand-alone or can be assembled into workflow-based applications. In the cloud-based exploitation solution, the authoring of these spatial models will be handled through a 100 percent web-based interface.

These products are currently in use throughout the federal civilian, defense, and intelligence communities (and well beyond these globally) and our cloud-based implementation of Spatial Modeler will increase accessibility by developing web-based applications that connect users with data and data processing resources.

It is noteworthy that ERDAS developed the original industry-first graphical spatial model authoring and execution mechanism back in the 1990's as part of the ERDAS IMAGINE product. Spatial models have been used extensively behind the scenes since then for a variety of the processing capabilities in ERDAS IMAGINE. Users have taken advantage of this mechanism to create thousands of different custom geospatial processes which are then executed in the ERDAS IMAGINE framework as part of geospatial workflows. In the last few years, our development teams have undertaken complete re-architecting of the Spatial Modeler, resulting in the much broader set of capabilities described in this paper. These capabilities are undergoing continuous improvement and expansion and are expanding into GeoMedia and other Hexagon products. The Spatial Modeler architecture is truly a cornerstone of future geospatial product developments throughout Hexagon.

6 A Revolutionary Approach to System Architecture

The Hexagon cloud-based exploitation solution is far beyond cloud-based access to world class applications like ERDAS IMAGINE and GeoMedia, rather it is a revolutionary approach to bringing vital geospatial capabilities to a larger number of users in a streamlined and elegant manner. This Hexagon solution is key to enabling many organizations to realize their vision and execute their strategies for moving to the cloud and is compatible with government cloud-deployment blueprints. The architecture consists of several key constructs: *operators, spatial models, web services,* and *cloud-based applications*.

Operators

Our product development teams have undertaken a process to decompose all of the core product functionality into hundreds of "building blocks" (individual operators). Essentially, this strategic initiative can be seen as transforming the applications into platforms, or an infrastructure. Core functionality is no longer constrained to the desktop application itself, but now has been liberated and made available through the cloud-based exploitation solution.

An operator is responsible for encapsulating a computational element that performs calculations, processes data, fuses information, analyzes, or visualizes a large variety of data formats. Operators exist as components to be used by Spatial Modeler and are primarily built using C++. The Hexagon cloud-based exploitation solution comes with a full complement of operators to support a wide range of geospatial processes. However, if an organization has requirements that cannot be met with the existing set, new operators can be developed.

The Spatial Modeler Software Development Kit (SMSDK) allows for creation of new operators using a C++ development environment. This can be used to create operators that incorporate third party algorithms, allowing for very powerful and seamless integration with the rest of the geospatial operators.

Spatial Modeler also provides two very powerful operators that allow for extending the capabilities of the operators and models without using the SM SDK. These are the Command Line and Python operators. The Command Line operator invokes a stand-alone executable that can be developed with any programming language. Python is a very popular cross-platform scripting language that is easy to learn and use. Python scripting is a popular tool for executing a variety of processes from different environments. The Python operator is used to execute a pre-built Python script. Additionally, existing operators or models can be called from an external Python script.

Examples of popular operators

Read and write various geographic file formats	Raster Input Raster Output Vector Input Shapefile Output	Point Cloud Input Point Cloud Output Warehouse Output
Execute external programs, run a Python script, or reference another model	CommandLine Python Script Spatial Model	
Define complex formulas	Expression	
Common image processing operators	Image Segmentation FLS Convolve Principal Components Histogram Match Unsupervised Classification	HistoEq Band Selection Stack Layers Stretch
Conditional operators	Conditional Criteria Either/Or	Index Pick
Terrain analysis	Aspect Slope	Insolation Relief
Vector analysis	Attribute Filter Buffer Rasterize	Spatial Query Warehouse Attribute Update
Point cloud operators	Classifier Point Cloud Reproject Point Cloud Volume	RGB Encode
Raster processing	Clump Correlation	Sieve Zonal Min, Max, Mean
Photogrammetry	Automatic Point Match Data Triangulation Ground Point to Image Image Pair to Ground Point	Orthorectify Tridicaon SGM
Attributes and Metadata	Attach Attributes Attribute Lookup GIS Statistics Global Histogram	Set to NoData Statistics

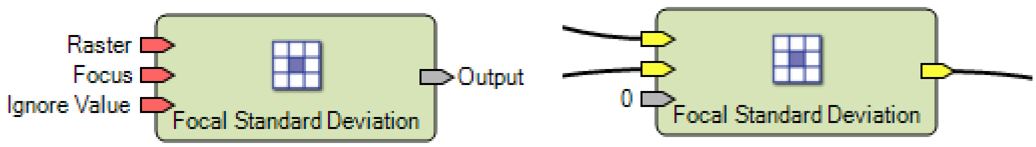
Each operator includes ports which describe the inputs, outputs, and parameters of the function. These ports dictate required inputs and prerequisites, ensuring that all necessary information is available prior to executing the operator. Operators are linked together using these ports. Some ports are optional. A properties dialog can be easily called up for each operator, and the optional ports can be turned on or off by checking or unchecking them in the Show column of the properties dialog.

The ports to be exposed for an operator are controlled by setting properties.

Properties

Show	Name	Value	Objects Supported	Required
✔	Raster		Raster	✔
✔	Focus		Matrix	✔
✔	Ignore Value	Integer (0)	Table, Scalar	
	Use Value		Table, Scalar	
	Use/Ignore Lookup Table		Table	
	Don't Apply at Value		Table, Scalar	
	Apply at Value		Table, Scalar	
	Apply Lookup Table		Table	
	FillWithNODATA	true	Bool	
✔	Output		Raster	

Unconnected Operator (left) and Connected Operator (right)



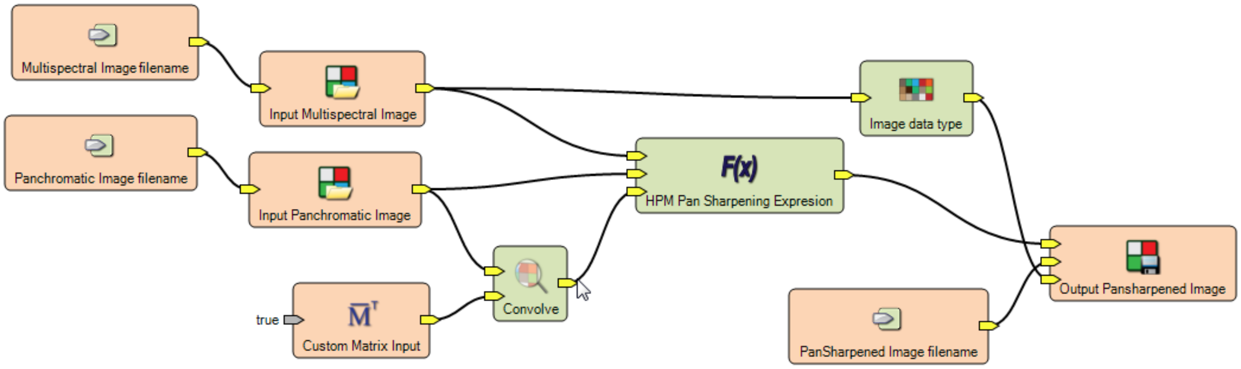
Spatial Models and Web Services

Using the Spatial Modeler authoring environment, operators are assembled into spatial models that execute specified geospatial workflows by defining relationships to data sources and other operators and models. Models may perform combinations of raster, vector, and point cloud operations. Models assemble sets of operators into more complex algorithms and relate to datasets and inputs and generate results. Existing models can be customized so that organizations can create important variations of them for specific purposes or create entirely new models. These models and the services created when they are published can be strung together in sequence, nested, and reorganized in many ways to support specific workflows. They can be tested step-by-step during development and results viewed in real-time, thereby accelerating the authoring cycle.

Spatial models can also be executed within the ERDAS IMAGINE software and can be sent to people via email so they can then drop them into their own environment and execute. However, a more effective approach is that these models are "published" as a RESTful web service for execution in the cloud and are therefore consumable by everyone else across the enterprise. In addition to the desktop authoring option, models can be fully built with a web-based authoring tool.

Through this approach, specialists and subject matter experts develop methods and algorithms, author and authenticate the models, and then publish them as cloud services. End users may then execute these approved geospatial web services in a reliable and consistent manner. This mechanism provides great flexibility for taking "best-of-breed" algorithms from different sources (government, academia, industry) and assembling them into services for broader use. This is a powerful force multiplier, since these subject matter experts now have a mechanism through which to effortlessly share their knowledge and expertise with an unlimited number of users. As they share their craft through this mechanism, all users across the enterprise, including mission partners, benefit. These reusable spatial models produce reliable results and save time and money every time the analyst runs them.

Example of operators assembled into a spatial model



Examples of key geospatial spatial model-based web services

Change Detection	Image to image, raster to raster, feature to feature, chart to chart
Synthetic Aperture Radar (SAR) Analysis	Despeckle, Level Slice, Filtering, Interferometry, Radar Coherence Anomaly Detection
Terrain Analysis	Line of Sight, Helicopter Landing Zones, Slope Analysis, Terrain Differencing, Terrain Shading, Rough and Finished Contours, Automatic Terrain Generation
Photogrammetry	Tie point generation, Triangulation, Orthorectification, Image registration
On Demand Map Generation	Execute cartographic web services (CWS): Create GeoTIFF from CWS, Create Geospatial PDF from CWS
LiDAR	Classify Point Cloud
Elevation Processing	Smooth Elevation Values, Remove Elevation Spikes, Flatten Terrain, Detect Vertical Obstructions
Image processing and Analysis	Feature Extraction, Adjust Pseudocolor Imagery, Distance form Signature, Generate Images for Stereo Viewport

Cloud-Based Applications

Once these operators have been assembled into models published as services, the next critical step is to “mint” them into stand-alone mission-specific applications, essentially creating very intuitive interfaces for accessing and executing the geospatial cloud services. These applications relate one or more models/services with specific data sources, provide a graphical user interface (GUI), and perform other processes.

It is important to draw a distinction here comparing these new cloud-based applications to existing desktop software where a “one size fits all” view exists. Because most users only take advantage of a small percentage of a desktop product’s full set of capabilities, it is possible to replace the desktop product with focused, mission-specific applications that more directly address-specific requirements and workflows pertaining to the organization. The result is a broad set of applications that all apply geospatial processing as an underlying infrastructure, which we call “geospatially enabled.”

Creating applications in this manner creates an important layer of abstraction between the user interface and the algorithms responsible for geospatial processing. This flexibility allows a tremendous number of applications—an important factor when we support a range of end-user devices and form factors, such as laptops, tablets, smart phones, and even smart watches. This approach also allows for companies and organizations to brand the end-user applications as their own and make them available via an enterprise or public marketplace. The abstraction layer also allows for organization and mission-specific graphics and terminology to be incorporated into the user interface, improving user interaction. These applications can be efficiently created via a "drag and drop" application builder interface that allows users to choose from a variety of GUI elements, such as graphs, dials, buttons, sliders, voice recognition, and text entry fields.

It is important to note that while geospatial processes being executed in the cloud by the applications use for example imagery, terrain models, and maps, some applications may purposely be designed not to provide a display of any of these items. Rather, the user interface may be a streamlined view into statistical results of a geospatial process, or some other summary-level information viewable from a dashboard on a smart phone.

Consider this scenario as an illustration of such an application: In support of a recent forest fire that has broken out in Payette National Forest, a U.S. Forest Service (USFS) geospatial analyst in Salt Lake City designs a geospatial service that detects changes between two sets of images. The first set of images represents the most recent clear-day coverage over Payette National Forest prior to the fire outbreak. The second set provides the most recent coverage while the fire is active. The results of the change detection service are displayed as a vector contour representing the extent of the fire damage area and the active fire line (or zone) itself. In this scenario, updated imagery is available in almost real-time because a stationary UAV is positioned overhead, so the analyst then creates an application that executes this change detection service at 15-minute intervals and compares change detection results to previous results to establish a trend over time of fire expansion or recession.

The results of the service in the scenario can be viewed in a number of ways. The field commander fighting the forest fire may choose to view results as a "percent contained" pie chart alongside the most recent overhead image in an app running on a tablet, while the Director of the USFS may choose to have the "percent contained" results sent as a text message feed to a smart watch that vibrates upon receipt of the message. The power and beauty of this solution is that these applications can be personalized in a way that ensures that each type of user receives exactly what they need in a manner most suitable for their mission.

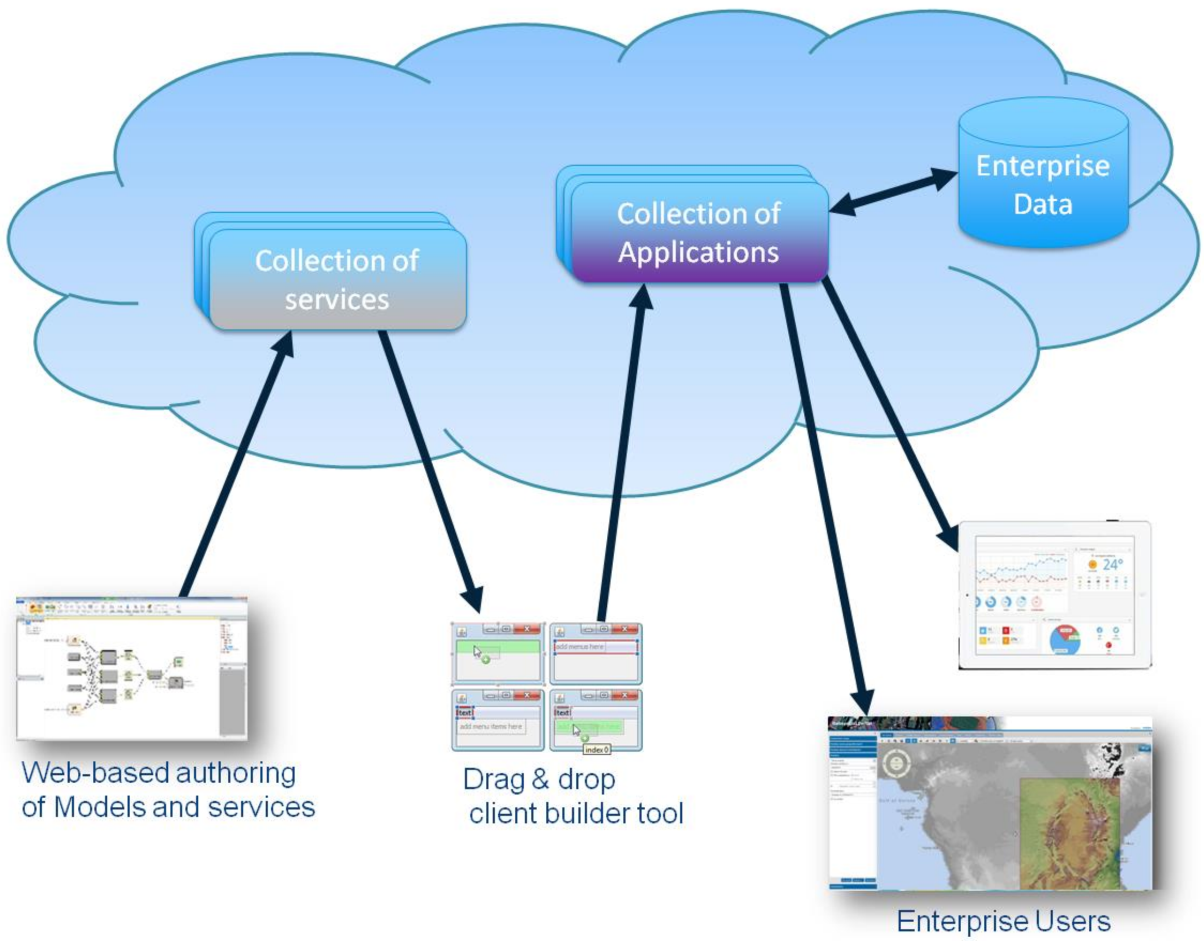
Some examples of additional applications include:

- An Army captain using a Toughbook is planning a route for a convoy and uses an interactive application connected to a cross-country mobility web service that lets him specify types and quantities of vehicles. The web service has been customized to also take into account recent weather conditions before it calculates the recommended route and displays the route superimposed over a map of the area.
- A FEMA executive views a post-hurricane debris cleanup report that was just emailed to her which shows the progress and effectiveness of several contractors involved in the cleanup effort. The report is automatically generated by a cloud-based web service by using a change detection web service that takes into account elevation change and performs volumetric computations. The contractors are then paid based on the amount of debris removed. The web service is run and the report is generated twice daily.
- An agricultural business analyst in control of a lightweight drone collects multi-spectral imagery over a number of farmers' crops. The system then automatically feeds those results to a cloud-based service that uploads the imagery into an online catalog. An analyst at the U.S.

Department of Agriculture receives an automated notification that new imagery is now available and fires up a cloud-based app that compares the latest imagery to known signatures of crop types, estimates the expected yield, extracts forecasted crop yield data from a different system, and compares the two via on-screen bar charts.

- An EPA analyst tasked with monitoring both intentional and accidental oil discharges at sea executes a cloud-based geospatial application that automates oil spill mapping. This application uses synthetic aperture radar data to detect oil spills near the U.S. coastline and specifically in the vicinities of offshore drilling platforms. The analyst spends much of his time in the field and accesses the app via a tablet with a secure wireless connection.
- A denial and deception analyst working for the Defense Intelligence Agency is looking for anomalies associated with a foreign manufacturing facility for evidence of weapons production. The immersive environment he works in provides access to a cloud-based application that queues up a series of hyperspectral images over the facility and performs a material analysis against a library of known signatures. A materials report is generated and viewed directly within the immersive display.

Hexagon Cloud-Based Exploitation Solution



Web-*Based* ***Image*** *Exploitation*

The Hexagon cloud-based exploitation solution also includes a versatile and powerful web-based electronic light table (ELT) capability, called WebGLT. Users can search for imagery, terrain, and vector data in a variety of formats and add it to a gallery for visualization and exploitation. It provides users with the choice of a native projective image space or planar geometry based visualization and a vector editing client.

Image/geospatial analysts have the ability to perform a complete set of image enhancements and imagery can be annotated and saved in various formats with overlays for insertion in reports. Features include precision georeferencing, vector editing, mensuration tools and intuitive image navigation techniques, including smooth manual and automated roam/pan, zoom, and rotate functions. Workflows for photogrammetry, GIS, and remote sensing are easily supported using Imagine Spatial Modeler or other REST-based geoprocessing services via the WebGLT interface.

Viewing and adjusting a satellite image in WebGLT

7 Supporting Disconnected and Mobile Users

It is important to also establish support for mobile and disconnected users within the cloud-based exploitation model in order for the reliability of mission-critical applications to be ensured for those users that may not have continuous network access. It is also important that these mobile applications work with local data sources in addition to the enterprise data sources that persist in the cloud. Some applications may even be configured to support specific disconnected workflows so that results of a geospatial process, or data collected in the field, are automatically synchronized with enterprise data sources when the device re-establishes connectivity.

The Hexagon cloud-based exploitation solution has robust support for mobile users, including the ability to develop applications with user interfaces optimized for mobile form factors. The solution also enables the development of field-based data collection applications that can operate in a disconnected mode if necessary and provide synchronization of field-collected data with enterprise databases when connectivity is re-established.

8 Additional Aspects

The Hexagon pricing model is flexible and dynamic. It is available based on customer need. Larger enterprises may find an annual subscription with annual adjustments more suitable to their organization's needs. Others may find it more advantageous to combine an annual subscription with the ability to consume our technology for a shorter period (daily or monthly) allowing the organization to pay for exactly what they use. These pricing solutions also provide for complete and accurate monitoring of usage allowing the organization to make improved and more informed buying decisions dynamically.

Even in this new cloud-based architecture, there may still be a need for some users to have access to the complete desktop version of ERDAS IMAGINE or GeoMedia software. An innovative approach to providing the full desktop application without a local machine installation is known as *Native as a Service* (NaaS) The NaaS platform uses a ground-breaking "cloudpaging" protocol for application virtualization and streaming technology. Cloudpaging delivers small fragments-"pages"-of software executables from cloud-based installations to the end user machines that execute them. These fragments are provided automatically as needed based on user interface activities and remain cached on the local system for a period of time.

Cloudpaging solves problems such as long download and installation times, cumbersome licensing systems that reduce or preclude the portability of applications, and large IT support footprints. Cloudpaging also solves typical web-app challenges such as limited feature sets, slow or unstable performance, and the ability to work with local datasets, thereby providing a seamless user experience. NaaS provides near-instant provisioning from the cloud without needing any changes to the underlying applications delivered from the service. NaaS can also support shorter term dropouts in connectivity in the middle of a processing activity due to the local caching aspect.

Hexagon partners with companies and government organizations to directly implement these capabilities. Hexagon maintains a staff of qualified professionals across the geospatial and IT disciplines and also provides on-site staff to continually maintain and enhance these systems. Hexagon staff will work with customer personnel to assess cloud-readiness, develop an implementation plan (which includes scoping of additional operators, services, and applications), and then develop, deliver, and support the solution. Hexagon also provides a range of training options related to all elements of the solution. The table below highlights the key features and benefits of the Hexagon cloud-based exploitation solution.

9 Conclusion

Features and Benefits of the Hexagon Cloud-Based Exploitation Solution

Feature	Benefit
Cloud-based services and application delivery	• Improves ubiquitous access to geospatial technology from wider number of devices and locations • Capabilities automatically scale as needed • Allows for monitoring of usage to support tuning • Reduced IT maintenance cost • Improved frequency of technology insertion eliminates long drawn-out technology refresh cycles, keeps workflows current and improves innovation
Platform based on ERDAS IMAGINE and GeoMedia functionality	• Processes generate reliable and accurate results • Robust support for a wide range of geospatial requirements and data types
Development of mission-specific applications vs. desktop applications	• Reduces training requirements and cost • Provides a more diverse set of applications • A wider set of users can use the technology that is no longer just restricted to product experts • Eliminates redundancy and cost of maintaining desktop applications (pay only for what you need)
Single exploitation environment for all geospatial disciplines, including support for third party models and workflows	• Improves productivity • Increased flexibility and diversity of solutions improves innovation
Centralized enterprise marketplace for applications	• Improves collaboration among analysts in sharing and executing common workflows in a consistent manner

While the Hexagon cloud-based solution has roots in its world-class flagship desktop products ERDAS IMAGINE and GeoMedia, it is not an incremental upgrade. It is a revolutionary solution platform that will transform the vision of the geospatial cloud into a reality and significantly increase the number of users that can leverage geospatial analysis without having subject matter expertise or expensive software. This provides the ability to more rapidly innovate and more broadly and effortlessly collaborate, thereby improving the overall effectiveness of the organization.

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