



EXELIS

Visual Information Solutions

ENVI in the Cloud

Raising Image Analytics to New Heights



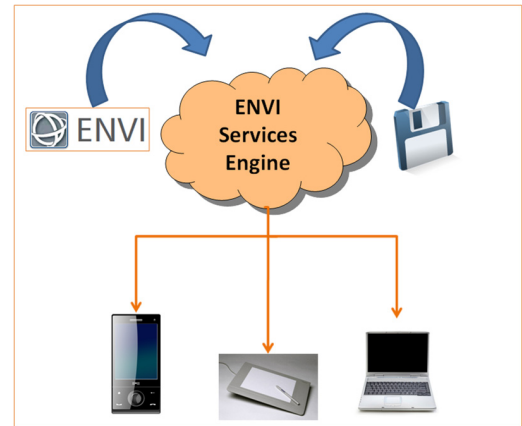
ENVI in the Cloud

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Abstract

The adoption of cloud computing by the geospatial industry has identified issues that have both inhibited and driven enterprise-level deployment of image analytics capabilities. Data and analytics requirements, shrinking budgets, and the need for simplified, interoperable workflows all drive the development and integration of cloud-based GIS. In response to these emerging needs, [Exelis Visual Information Solutions](#) has created the ENVI Services Engine, which incorporates open source standards and middleware-agnostic architecture to bring the image analysis capabilities of its ENVI product to the cloud. The engine provides online, on-demand access to information derived from remotely sensed data.

The purpose of this paper is to identify both the issues and potential benefits of integrating image analytics into the cloud, and to explore the capabilities of the ENVI Services Engine when deployed at an enterprise level.



ENVI in the Cloud

Why Image Analytics in the Cloud?

Cloud computing has been around for decades. Even in the early days of the mighty mainframe computer programmers were thinking of new ways to connect multiple users to a single computer to reduce overhead costs and computation time. In today's world these challenges still exist, albeit with a new twist. The terminals of yesteryear were access points to the larger computing power of the mainframe in the same way that our desktops, laptops, tablets, and mobiles are interfaces into the larger computing power of the cloud. Many of the limitations experienced back in the day are prevalent today, just on a much larger scale.

GEOSPATIAL BUDGETS ARE SHRINKING

In today's economy, the ability for large-scale corporations to install hundreds, if not thousands, of individually licensed machines throughout their business is cost-prohibitive. The move towards desktop virtualization with enterprise-wide software installs provides a centralized framework that is cost-efficient and easily managed.

DATA VOLUMES AND ANALYSIS REQUIREMENTS ARE INCREASING

Many companies now measure their storage space in petabytes. As new geospatial functionality is moved into the marketplace, the need for more storage, faster data retrieval, and quick, reliable data analysis is paramount. At the same time, the need to access and analyze this data from remote environments is also on the rise, creating a scenario where more computing power and storage is needed on smaller, less connected devices.

GEOSPATIAL RESOURCES NEED TO BE STREAMLINED

The cost of running a server can be high, and the ability to maximize the use of the server for running specific tasks ultimately translates into cost-efficiency for the company. The ability to manage numerous applications and software packages from a single resource allows for the most efficient use of a company's GIS resources.

Naturally, today's computing world is much different than that of 50 years ago, resulting in new challenges that can be solved through the use of cloud computing.

ENVI in the Cloud

Raising Image Analytics to New Heights

GIS CONSUMED BY NON-TECHNICAL USERS

GIS continues to move into the commercial mainstream, and many companies are leveraging advanced analysis to help guide their business decisions. As geospatial information is incorporated into a company's workflow, there often exists a lack of technical resources to exploit that information. This lack of technical GIS resources, combined with the ubiquitous nature of the cloud, has created an environment where non-technical users are looking for simple, self-service tools that can provide accurate, reliable information.

THE SEARCH FOR 'BEST IN CLASS' SERVICES

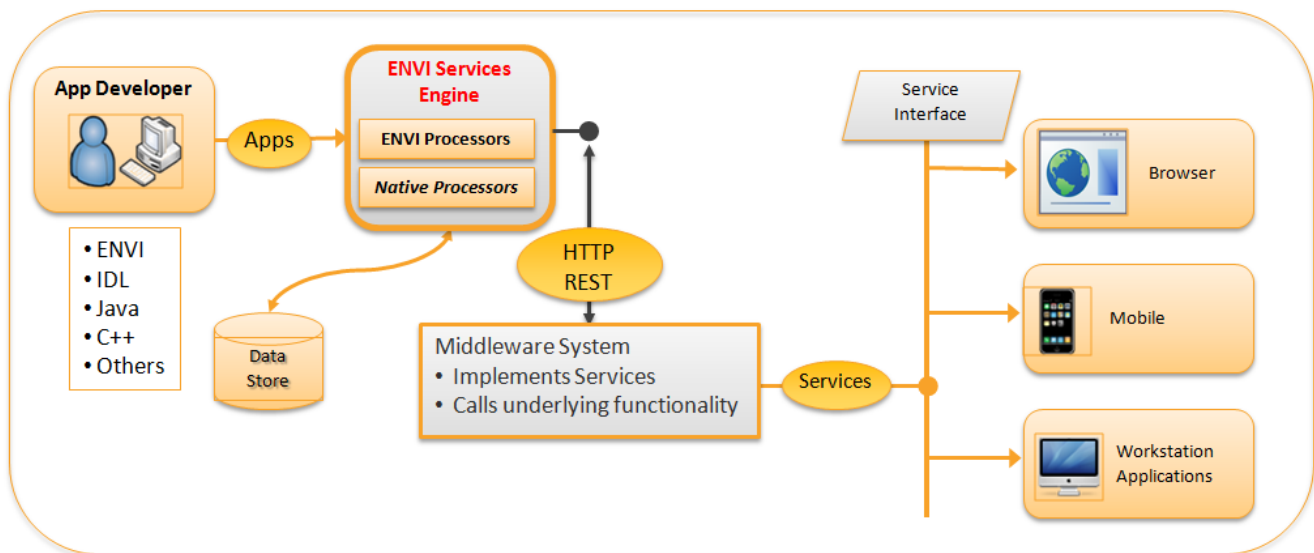
There are literally thousands of developers pushing GIS capabilities into the cloud. While robust desktop software is needed for image analysis workstations, the cloud allows the enterprise to leverage Software as a Service (SaaS), which means a business can selectively choose the functionality they would like to use without having to pay for functionality that they will not use. Having image analysis tasks that are customized to an organization's specific workflow can increase productivity and reduce costs. The cloud also allows for companies to purchase functionality slices from various sources, creating an environment where a company can consume 'best in class' services.

ENTERPRISE ENVIRONMENTS ARE EASILY MANAGED

The desktop network that has defined the IT infrastructure of the last two decades has created a breakdown in data sharing, software management, and overall communication within the business. An enterprise-wide server environment allows for centralized management of users, software, and data.

How is Analysis Deployed and Accessed in the Cloud?

Exelis Visual Information Systems has developed a cloud-based dissemination mechanism for the image analytics capabilities of its ENVI product. ENVI is an advanced image analysis software package that allows users to extract useful information from remotely sensed data. ENVI is compatible with over a hundred different data types and contains hundreds of analysis functions. The ENVI Services Engine, places this analysis capability at an enterprise level. It is deployable within the cloud and leverages a number of vetted specifications to allow for middleware agnostic interoperability with any enterprise IT infrastructure.

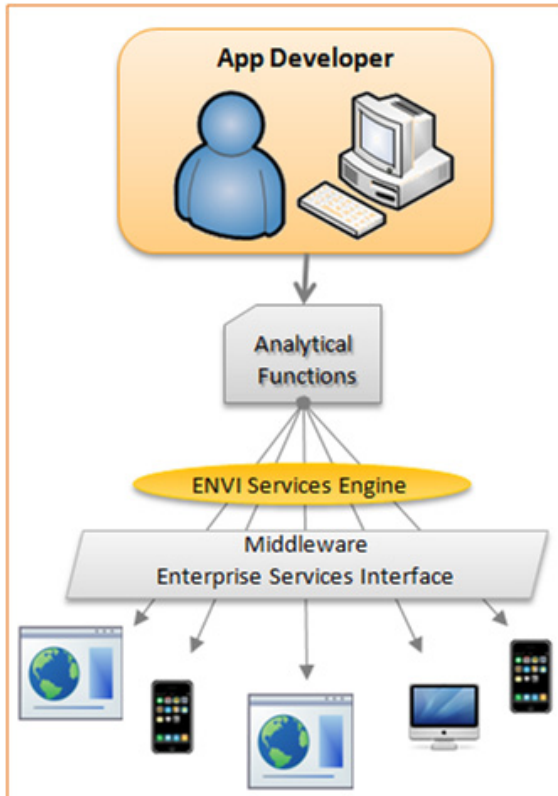


The ENVI Services Engine Architecture

ENVI in the Cloud

Raising Image Analytics to New Heights

The design of the engine allows an app developer to build customized applications in a number of different programming languages that leverage the power of ENVI image analysis algorithms for consumption via thin or mobile clients. HTTP REST requests made to the ENVI Services Engine from a middleware component will subsequently call and run this functionality, with the results being pushed back through the middleware components to the requesting application.

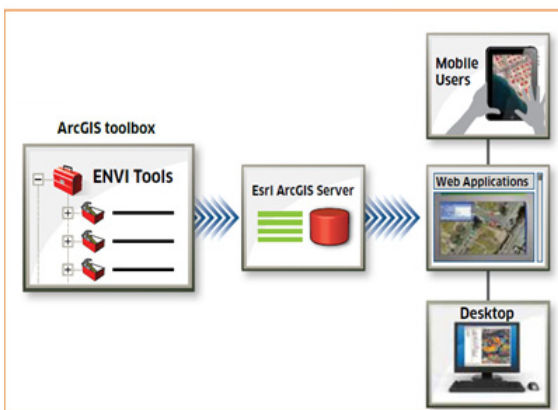


Developing Apps for the Services Engine

The ENVI Services Engine supports integration into a wide variety of environments, from Java Enterprise environments to custom batch workflows. Once an ENVI routine is developed, it is simple to wrap it as a service and deploy it in the engine for consumption by remote end users, other apps, or services running in the enterprise. Processing requests are passed through to the Engine via HTTP REST calls. Results are delivered back from the Engine and can be saved out, utilized in further analysis, or displayed in a variety of web, desktop, or mobile clients, depending on the customer's implementation. The engine is delivered with basic instructions for developing and deploying ENVI-based services, instructions for integrating the engine, and a reference service implementation.

ENVI for ArcGIS® Server

Exelis also has a customized solution for [Esri's ArcGIS®](#) for Server, which embeds ENVI image analysis functionality into the ArcGIS® for Server environment. Exposing ENVI image analysis capabilities to the ArcGIS® Server environment enables you to leverage server class resources to analyze large image scenes and take full advantage of the information in imagery from remote clients. ENVI for ArcGIS® Server is also compatible with ArcGIS Web Mapping, which means you can easily create, manage, and distribute ENVI image analysis tools and models over the enterprise to desktop, mobile clients, or web applications.



ENVI for ArcGIS® Server

Publishing tools and models with ENVI image analysis capabilities helps the organization increase efficiency, improve the decision-making process, and maximize return on investment. With an ENVI desktop license, ENVI image analysis tools are readily available in the familiar ArcGIS® environment and can be used to author powerful GIS applications. Once tools and models are built, you can publish them to users across the enterprise. This enables the custom image analysis tools and models you create to be readily available and utilized across your entire organization within the ArcGIS® product suite. The tools available via ENVI for ArcGIS® Server can automate complex image processing tasks such as RPC orthorectification, change detection, and land classification, which means users of all ability levels can take advantage of the geographic information they provide.

ENVI in the Cloud

Raising Image Analytics to New Heights

Why Leverage Image Analytics in the Cloud?

REMOTE ACCESS

One of the largest benefits of deploying image analytics in the cloud is the ability to run complex, resource intensive analysis on extremely large datasets from thin or mobile clients. By moving the analysis to the data, the need for high powered, localized clients is eliminated in favor of lightweight applications that can call analysis functions via the web.

RESOURCE CONSIDERATIONS

Implementing cloud based image analytics has a number of benefits for a business. A single server that contains and distributes all of the data and software needs of an organization provides a single IT resource that is easily managed. It allows for all of the licensing and user administration to occur in a single place, which can eliminate unused licenses or functionality. A centralized system also provides for easier updating, allowing the administrator to perform faster, more frequent updates to the system as opposed to pushing updates to a network of desktops. All of these result in monetary savings for the company. Reduced hardware and software costs, combined with reduced overhead for support and maintenance are all benefits of deploying enterprise-level software.

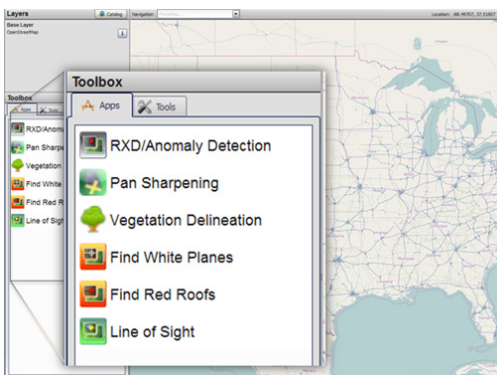
THE HTTP REST INTERFACE MEANS THAT THE ENGINE CAN BE DEPLOYED IN CONJUNCTION WITH ALMOST ANY EXISTING MIDDLEWARE CONFIGURATION. THIS MEANS THAT LESS WORK WILL NEED TO BE DONE CONFIGURING THE ENVI SERVICES ENGINE TO WORK WITHIN YOUR EXISTING INFRASTRUCTURE.

INTEROPERABILITY

The ENVI Services Engine is completely interoperable with a business's existing architecture. The HTTP REST interface means that the engine can be deployed in conjunction with almost any existing middleware configuration. This means that less work will need to be done configuring the ENVI Services Engine to work within your existing infrastructure. Another benefit of the engine's interoperability is the 'code once, deploy many' concept. This means that code written to expose a specific functionality can be wrapped and served via the engine to multiple environments such as desktop, web, or mobile.

USER COLLABORATION

A centralized repository for data and analysis functionality increases collaboration among disconnected users. In many instances, users from different parts of the same organization may be using different software packages to conduct similar work. This can result in inconsistent workflows, erroneous results, and even incompatible outputs. A single deployment of a vetted analysis software package can provide consistent and repeatable processes across the organization. The ability to create custom workflows for dissemination across multiple environments means that non-technical, remote users can perform complex analysis with successful results.



Packaged Functionality as Apps

A Reference Implementation

ENVI Services Engine allows the user to package a specific piece of ENVI analytical functionality and wrap it as a callable service for the engine. This results in pre-defined 'apps' that contain executable portions of the ENVI code base. Below is an example of how an application could utilize the engine.

ENVI in the Cloud

Raising Image Analytics to New Heights

This reference implementation leverages a series of open-source standards and components to highlight the flexibility and interoperability of the engine. For this implementation, the following ENVI functionality 'apps' were developed by quickly repurposing existing ENVI code:

Anomaly Detection - Allows the user to find specific instances of anomalous materials from a large, uniform scene. This is helpful for targeting specific areas in large datasets and reducing time spent manually combing through the data.

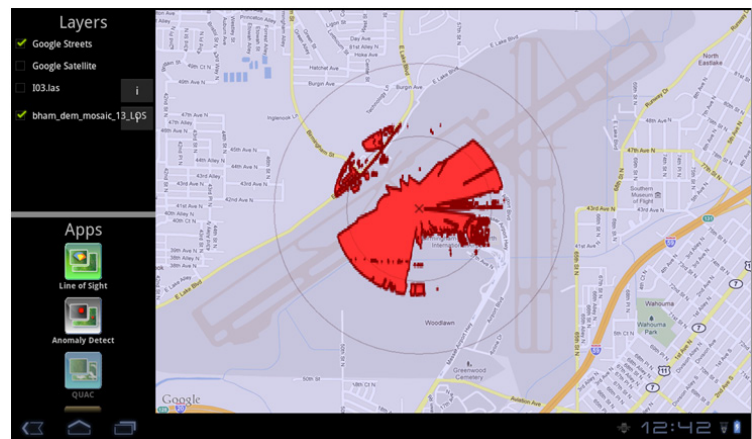
Pan Sharpening - Allows the user to sharpen multispectral datasets by fusing it with higher resolution panchromatic data.

Vegetation Delineation - Allows the user to quickly identify the presence of vegetation and to visualize its level of vigor.

Line of Sight - This application leverages ENVI terrain analysis capabilities to build a viewshed of an area based on a digital elevation model, and the location and radius of the target.

Find Red Roofs and Find White Planes - Both of these applications are workflow specific functions that leverage certain Target Detection algorithms for identifying a specific feature type in a scene.

This scenario envisions a web client or mobile app calling ENVI Services Engine via a middleware component such as MapServer or GeoServer. The thin and mobile clients are used to discover data using a cataloguing specification such as Web Catalog Service (CS-W) and to make Open Geospatial Consortium (OGC)-compliant analysis requests via Web Processing Service (WPS) calls to the engine via the middleware. The middleware component passes the request via an HTTP REST call, and the engine runs the requested analysis and pushes back the results using another open source specification such as Web Map Service (WMS) or a Web Feature Service (WFS) response. The flexible architecture of ENVI Services Engine allows you to plug directly into your customized interfaces via HTTP REST.



Line of Sight app being run on Android Client

Interoperability with the US Government

One of the [National Geospatial Intelligence Agency's](#) (NGA) strategic objectives over the next 4 years is an Open IT Environment. According to the [NGA Strategy 2013 - 2017](#) document, the goal is to "Leverage and rapidly deploy interoperable collection, processing, and exploitation capabilities...NGA will develop and deploy intuitive online services that are available for adoption and integration by the GEOINT community. These applications will provide immediate access to GEOINT processing and exploitation capabilities, enabling rapid and precise responses to key intelligence issues." According to the document, "This enables a self-assisted, full-service delivery

CLOUD-DEPLOYED ANALYTICAL FUNCTIONALITY ALLOWS FOR IMMEDIATE ACCESS TO GEOINT PROCESSING AND EXPLOITATION CAPABILITIES...

ENVI in the Cloud

Raising Image Analytics to New Heights

model that allows users to create and consume GEOINT content anytime on the device of their choice.”

The ENVI Services Engine falls directly in line with this vision. Cloud-deployed analytical functionality allows for immediate access to GEOINT processing and exploitation capabilities as mentioned in the strategic document. The interoperability of the engine allows for the creation and consumption of analysis algorithms on the device of the user’s choice, all while being maintained on a single server instance in an Open IT environment. This IT environment is based upon interoperability standards that define how various GEOINT technologies will communicate with each other.

The middleware-agnostic design of ENVI Services Engine means that it can be fully leveraged via the standards approved by the [Geospatial Intelligence Standards Working Group](#) (GWG), an NGA led organization responsible for adopting interoperability standards in support of the National System for Geospatial Intelligence (NSG). Among the standards approved by the GWG are numerous (OGC) standards including WPS, WMS, WFS, CS-W, and more. This means that ENVI Services Engine is fully in-line with the NSG’s GEOINT standards, which are the guidelines for implementing NGA’s vision for the next four years.

Conclusion

The adoption of cloud computing by the geospatial industry has allowed businesses to address a number of old and new problems that have both inhibited and driven enterprise-level deployment of image analytics capabilities. Ever-increasing data and analytics requirements, combined with shrinking budgets and the need for simplified, interoperable workflows necessitates a collaborative set of standards by which open source components of an enterprise system can communicate.

Exelis Visual Information Solutions has created ENVI Services Engine, which incorporates open source standards and middleware-agnostic architecture to bring the image analysis capabilities of its ENVI product to the cloud. This approach takes resource and interoperability needs into consideration while promoting user collaboration across the entire enterprise. The engine’s architecture allows for the deployment of analysis functionality across multiple platforms from a single published resource, allowing remote users to leverage advanced, resource-intensive analysis on large datasets from thin or mobile clients. The ENVI Services Engine also aligns with NGA’s vision for 2013 – 2017, adhering to the interoperability standards outlined by the GWG in an effort to integrate with existing and future GEOINT networks.

The ability to host and disseminate data and complex functionality within the cloud will inevitably lead towards enterprise-wide hosting and dissemination of this information in the future. The work behind ENVI Services Engine is aimed at making this concept a reality. By targeting the changing needs of the enterprise-level community, and staying up to date on the most current interoperability standards, we hope to provide a cloud-based image analysis solution that provides businesses with all of the benefits that cloud computing has to offer.

Resources

National Geospatial Intelligence Agency’s Strategy – 2013 – 2017.

https://www1.nga.mil/About/NGAStrategy/Documents/19639_NGA%20Strat%20Pub_Public_Web.pdf

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