OMAR™

(Ossim Mapping and ARchiving)

Overview

The availability of geo-spatial data sets is exploding. New satellites, aerial platforms, video feeds, GPS tagged digital photos, and traditional GIS information dramatically increase across the globe. These raw materials need to dynamically processed, combined and correlated to generate value added information products to answer a wide range of questions.

OMAR™ is a web based system for archival, retrieval, processing, and distribution of geo-spatial assets. Satellite and aerial images, vector sets, UAV video sets, as well as user generated tags and reference items can be searched and manipulated with the system. Searching can be performed on the basis of location, time, or any combination of the stored metadata.

OMAR™ is unique in its ability to dynamically process raw materials and create value added products on the fly. Imagery is ortho-rectified, precision terrain corrected, and histogram stretched on demand. OMAR™ can combine, fuse, or chip areas of interest according to the users needs.

Geospatial assets can then be manipulated, viewed, and processed to provide a wide range of value added products. The value added products will be delivered through several mechanisms:

- Generated product distributed through ftp or email (planned)
- Results generated with a simple browser interface
- Open standards and interfaces (OGC WMS, WFS, WCS, tiling services)

OMAR™ is under active development through US Government funding. OSSIM and OMAR™ development is being funded by a number of intelligence and defense agencies in including the Department of Defense, the National Reconnaissance Office, and the National Geospatial Intelligence Agency. While there are plugin modules that are classified, the OSSIM project is managed and maintained on the internet in an unclassified environment.

OMAR™ integrates several open source software solutions to provide an online dynamic processing solution. OpenLayers, PostGIS/Postgres, GRAILS, and OSSIM are a few of the technologies that are used in the development.

OMAR™ is part of the OSSIM open source software baseline hosted at http://www.ossim.org . OSSIM is one of the founding projects of the OSGeo Foundation http://www.osgeo.org .

The Open Source Business Model

OMAR™ is an open source solution trademarked by RadiantBlue Technologies Inc. It is part of the OSSIM open source software baseline. Since 1999, OSSIM has evolved through US Government funding from the Defense and Intelligence communities. Throughout that period, the core development team has worked in a number of different companies while maintaining a close collaborative relationship. The combined OSSIM team has supported a number of different customers. As a result, OSSIM is now deployed in a number of critical government and commercial applications. Over time, a number of solutions and applications have evolved out of the core libraries. Solutions include command line applications, the ImageLinker prototyping tool, ossimPlanet for 3D visualization and collaboration, and OMAR™ for online geospatial management and production.

OSSIM has been supported by a number of government agencies through the funding of professional development services. Typically, an agency will hire OSSIM developers to add functionality and meet agency requirements through the use of OSSIM solutions. One of the demonstrated advantages of an open source approach has been frictionless collaboration between all of the projects and contributors. Government customers rapidly become converts to this model as they begin to inherit and apply improvements that were funded from other agencies and projects. All participants share in the benefits when they contribute with funding support.

The advantages of an open source software approach is becoming evident within the US Government. Recent changes in policy and acquisition practices have spread the adoption of these practices. Successful projects such as OMAR™ and OSSIM are providing useful solutions as projects and programs evaluate this approach.

The open source software business model is supported through professional services within the US Federal government. Various agencies are funding professional services to extend and support OMAR™, OSSIM and other OSS geo-spatial technologies. OMAR™ is a COTs[1] solution consisting of open source software. Source code is delivered with the solution, collaboration between agencies and contractors on the baseline is actively encouraged and supported. Open source solutions and support is being implemented across all levels of the government enterprise. RadiantBlue Technologies Inc. provides professional services and support for the OSSIM baseline and the OMAR™ solution.

OMAR™ is currently being funded for operational transition. The software team will deliver the first operationally configured release before the end of 2010.

This document will summarize the capabilities for OMAR™ as well as plans for near term development.

[1] OSS solutions are considered COTs within the FAR

OMAR™ Capabilities

The relational database and geospatial processing capabilities allow rapid generation of value added information products from raw information. Delivery of this processed information can take the form of generated products, web browser views, or on demand web based services.

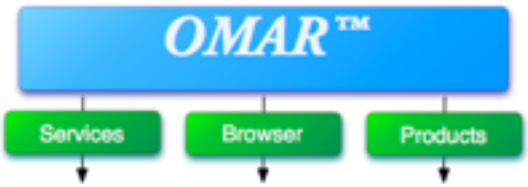


Figure 1. *Results delivered as Services, through a Browser, or through output Products*

OMAR™'s rapid cataloging and provisioning capabilities rapidly locate, process, and distributed value added products across the enterprise. OMAR™ can automatically detect, ingest, and process when new geospatial assets arrive in any of the monitored repositories. While there are a number of systems that can discover and distribute geospatial assets - this system is unique in its ability to process those assets into derivative products and services on demand.

The included OSSIM geo-spatial processing engine can construct image chains that define the functions, parameters, and conversions that are needed to read, re-project, and process the original geospatial assets into value added derivative products and services.

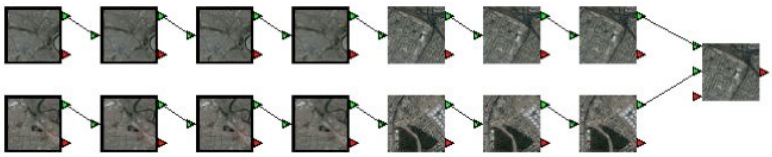


Figure 2. Image chains are parameter driven instructions that describe how to build a value added product. These take the form of 'spec' files that can be stored in the database.

Current installations of OMAR™ are managing millions of imagery and video files. The system is being used to find and rapidly view geospatial assets from multiple repositories.

A few of the existing features of OMAR™ 1.8 are:

Discovery and Online viewing of imagery and video

National and commercial imagery as well as UAV Predator video is being ingested, stored and viewed in the system. Online browsing of imagery is provided by OpenLayers and OSSIM, playback of video clips is currently provided by an external streaming service.

Searching based on location, acquisition time, and metadata

Interfaces with the embedded PostGIS/Postgres relational database provide the ability to select assets based on location, time, or any of the values in the metadata. In national systems this includes sensor types, target identifiers, and various collection criteria.

OGC Web Mapping Service (WMS)

WMS Services are currently provided by embedded MapServer functionality. The WMS interface coupled with the background OSSIM processing enables products and views to be composed on demand.

OGC Web Feature Service (WFS)

Initial WFS support is provided through MapServer and OpenLayers. This support will be streamlined and enhanced in future releases.

Native file access (OSSIM/GDAL)

OSSIM and GDAL provide support for a wide array of native geospatial formats. These libraries can provide file format conversion and allow assets to be reference and used without intermediate conversion. Commercial and national sensor are supported.

On demand ortho-rectification

The OSSIM library provides on the fly reprojection and ortho-rectification for the output. Satellite and aerial images are processed through OSSIM sensor models to map projected products.

On demand precision terrain correction

Rigorous and RPC sensor models apply precision terrain correction to DTED, SRTM or raster elevation data sets that are referenced to the system.

Dynamic Image Chain processing (processing templates)

OSSIM creates complex products from ‘spec’ files. The spec files define the parameters and processing steps needed to build a product. These image chains are being used in OMAR™ to define processing and views based on demand. Future development will store user defined processes in the database for custom products.

Mosaic and Fusion capabilities

Multi-image mosaics and fusions are being produced by the OMAR™ system in pre-defined image chains. New services and variations will be exposed in the future.

Format Conversion

OSSIM and GDAL can provide file format conversion services. The user interface needs to be extended to expose this for user generated products.

KML Layer addition

A recent addition was made in the staging process to automatically add <filename_root>.kml as an additional layer.

Time Bar

A time bar widget has been added to the interface to provide for the rapid selection of date/time criteria for returned results.

Re-projection and Datum Shifting Services

OSSIM dynamically re-projects data into geographic views. User selectable map projections and datums needs to be exposed through the user interface. The underlying conversion process already exists.

Area of Interest cropping (chipping)

User defined areas of interest can be identified through the WMS interfaces. The underlying architecture has the ability to generate area of interest products and services for interfaces with external systems and user requests.

Much of the current development work is focused on exposing existing processing capabilities through the user interface, defining and implementing services, and developing targeted image chains for specific functionality.

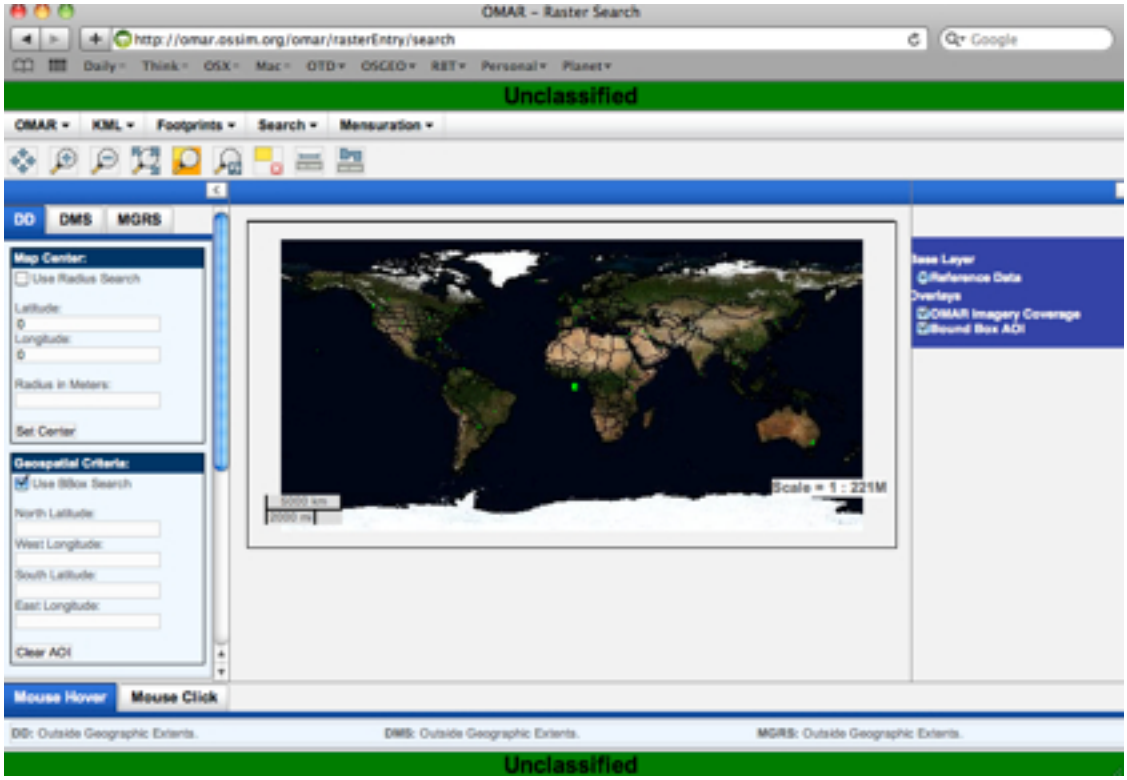


Figure 3 The OMAR™ web interface for searching for geo-spatial assets. The administrator has the ability to add new tags and criteria to the search panel shown on the left.

OMAR™ Walkthrough

Access through the system is authenticated through a user login. LDAP authentication is currently in development. Roles and privileges are granted based on the results. The current version of OMAR™ support two levels - users and administrators.

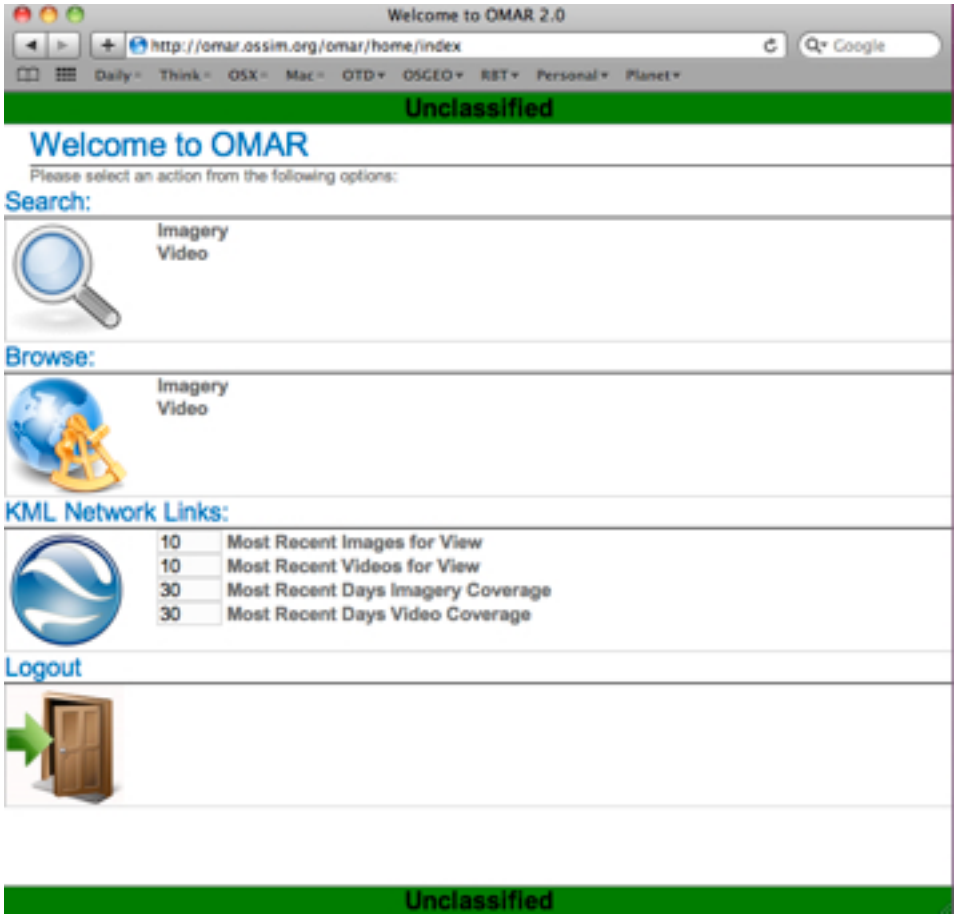


Figure 4 OMAR™ initial interface for browsing and searching

Typically, the user will search for geospatial assets through by selecting a geographic area of interest and filtering by acquisition date, sensor type, target identifiers, or any combination of the meta data tags that are stored in the internal database.

Figure 5 The imagery search search web interface provides a map that the user can pan or zoom to select a desired area of interest. Zooming the map to particular area of interest will reveal outlines of data sets that are available in the system.

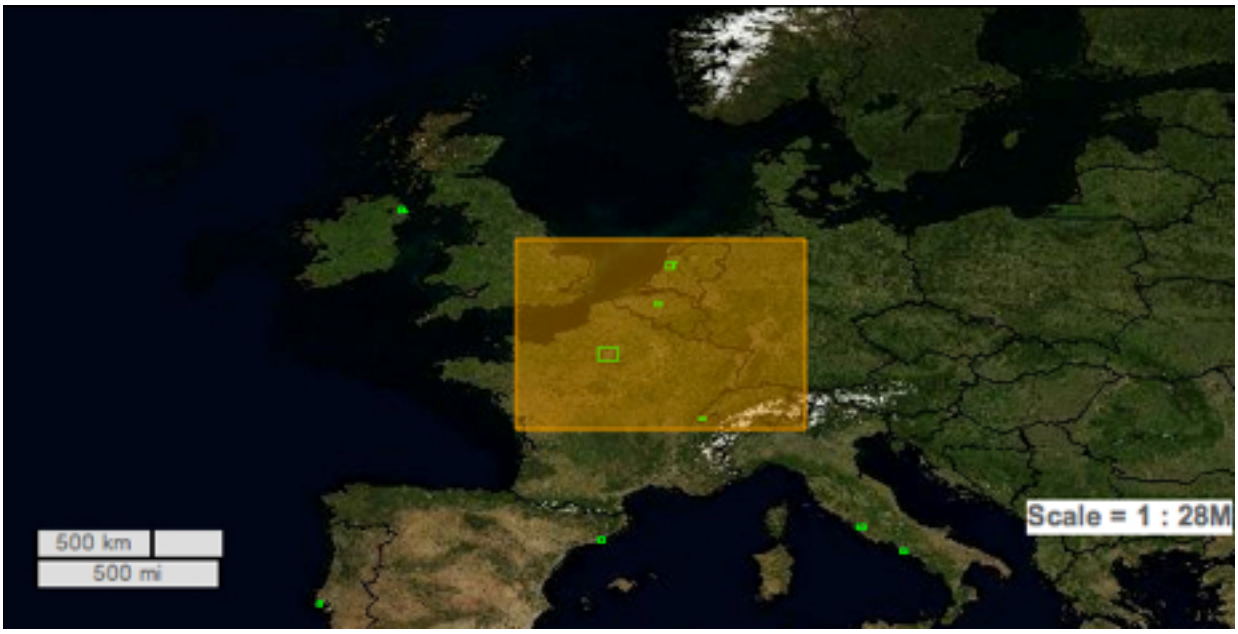


Figure 6 The user can then select the Area of Interest mode and draw a selection rectangle over the desired area for search.

Additionally, the fields in the left panel can be filled to further filter the search for data.

A number of parameters are available for search criteria. The user can manually enter center and corner coordinates, acquisition time and date parameters or values for any of the metadata tags. In many government applications this will include sensor ids, target identifiers, sensor types, or resolution criteria.

When the search button is pressed the results are displayed.

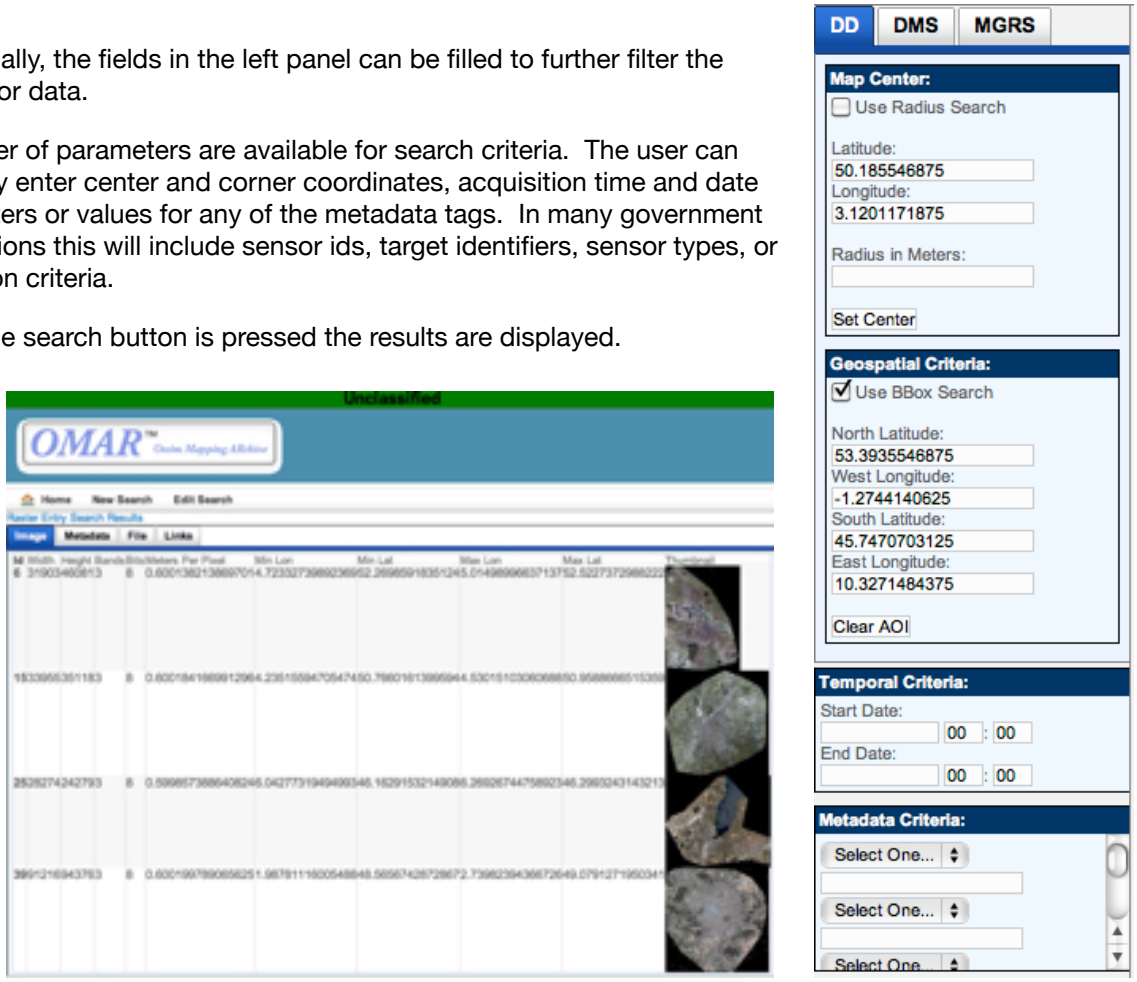


Figure 7. Configurable metadata parameters and overviews of the data assets are displayed. Clicking on the overview thumbnail will allow interactive viewing of the full data set.

The following sequence demonstrates interactive zooming and panning into a satellite image of Baghdad. Behind the scenes OSSIM is processing the raw file through a sensor model, cropping and zooming into the image, and enhancing the image with histogram stretching and sharpening.

Figure 8 Roaming, Panning and Zooming is accomplished interactively. The underlying image is being projected through a sensor model, orthorectified, precision terrain corrected and histogram stretched on the fly.

UAV Video

OMAR™ also can process UAV Predator feeds. These feeds can be searched, selected and played back through the web browser.

OMAR™ is able to extract and parse the metadata from Motion Imagery Standards Board (MISB) compliant video streams. Missions, acquisition dates and times, platform and center of interest coordinates are used to populate the internal database and position the data for geographic searches.

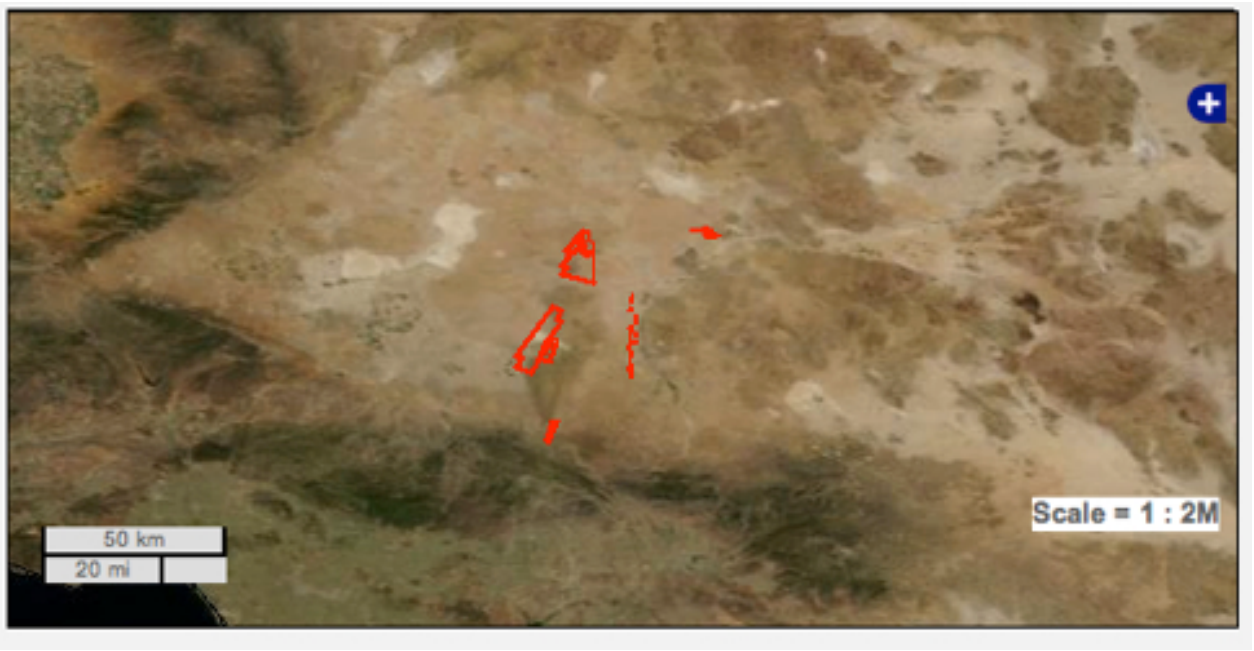


Figure 9 Ground tracks of UAV feeds are calculated and displayed from the metadata stream. Users can filter based on time, location, and mission.

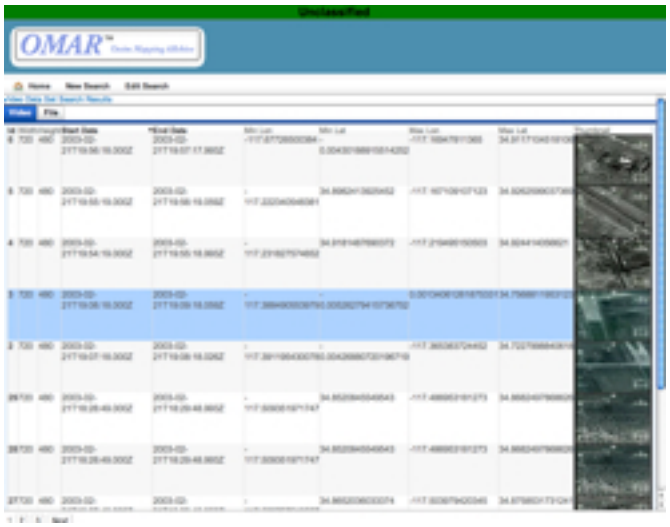


Figure 10 Video Search results and metadata

Figure 11 Selected video playback is streamed back through the browser. (Flash plugin or HTML5)

Additional Interfaces

OMAR™ supports SOA interfaces and has a defined application interface (API) that currently serves other systems. For example, the Core system requests image chips that are subsequently wrapped as KML for Google Earth. RSS feed mechanisms are available to provide user alerts when new data is processed. The OGC WMS interfaces can serve imagery into desktop tools. Initial work has commenced in supporting mobile devices such as the iphone and ipad.

There are several modes of operations for use with Google Earth™.

Individual images through KML links

Individual videos through placemarks and play back

- Last 10 images in the view
- Last 10 videos in the view
- Most recent image coverage
- Most recent video coverage

OMAR™ calculates and feeds the Google Earth™ OMAR layer

Architecture Overview

OMAR™ is an integration of several successful open source software projects to provide an enterprise solution for geospatial data management, production, and distribution. Defense and Intelligence agencies of the US government have provided funding to support OMAR™ and the underlying OSSIM software libraries. Through this support the OSSIM development team have been employed through a number of collaborating projects.

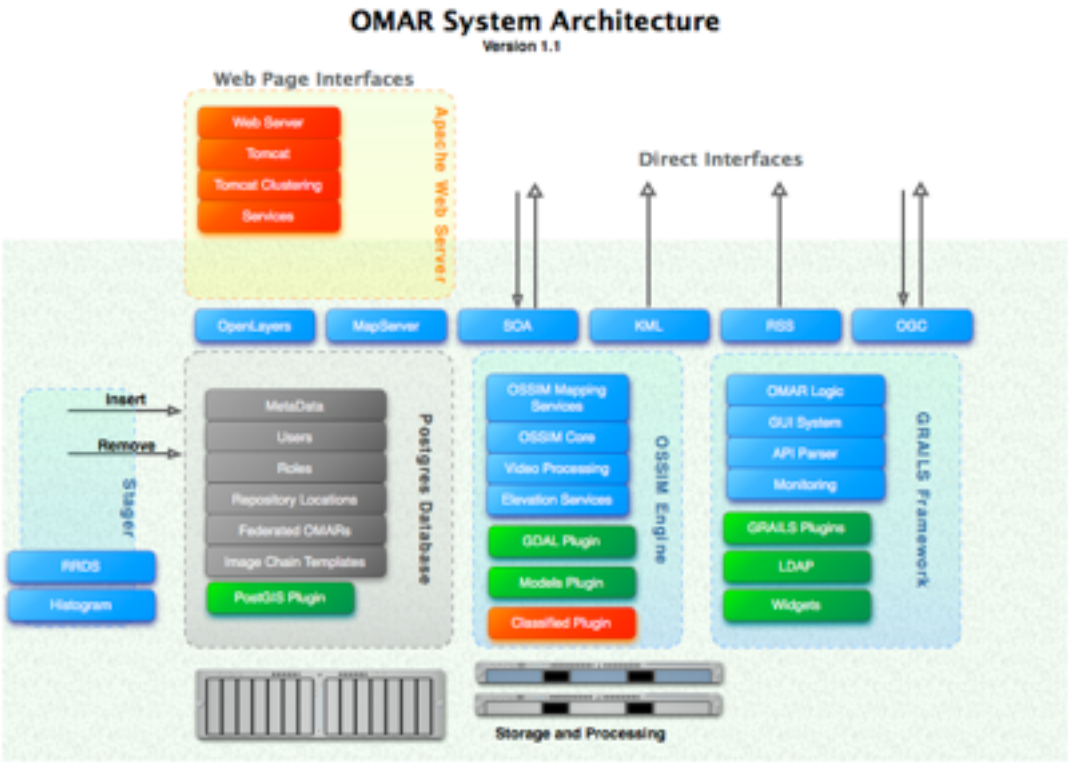


Figure 12 Overview of the system architecture for OMAR™

Summary

Interest in OMAR™ is gaining across a number of agencies and it will soon evolve to a formal government project. Maintaining OSSIM as an unclassified open source project on the internet has been key to its success and its ability to collaborate across a number of separate government projects.

The OSSIM team is always looking for additional contributors, developers, and users. Additional information can be found at http://www.ossim.org . OSSIM is one of the founding projects of the OSGeo Foundation http://www.osgeo.org .

Frequently Asked Questions.

Where does OMAR™ get its data from?

OMAR™ can stage from a number of file repositories and can automatically check those directories for new data sets. A path to each file that is staged is automatically entered into the database. Supporting files such as reduced resolution sets and histograms are generated in place or in a specified cache.

Is OMAR™ a client or a server?

OMAR™ is best thought of as a web server that contains a spatially enabled relational database and a geospatial processing engine that can create new products out of raw materials. Users interface with the OMAR™ system through a browser, SOA compliant services, or the OMAR™ API.

How does OMAR™ deliver products to users?

“Products” are generated based on user input with the internal OSSIM geospatial processing engine. The resulting files are created on local storage within the OMAR™ file system.

Future enhancements

- provide email notifications to the user with embedded links for file retrieval
- push the file to a predetermined location base on the setting in the users preference followed by completion email. Currently implemented on CSTARs.

“Services” are available through standard SOAP service mechanisms.

How does OMAR™ ingest data?

An OMAR™ stager is included in the system. Repositories are traversed seeking geospatial files that are not currently loaded in the relational database. Once the files are encountered supporting files are generated including reduced resolution data sets, thumbnails, screen views, and histogram files. The internal metadata is then stored in the relational database along with a file path back to the original file.

Can OMAR™ work over low bandwidth to disadvantaged users? Does OMAR™ support JPIP streaming?

The browser interface only sends the pixels that need to be displayed at the client end. Remote disadvantaged users can roam and zoom into multiple gigabyte files over connection paths with limited bandwidth. The underlying OSSIM library supports the Kakadu JPeg 2000 format. Future plans are to support JPIP streaming from OMAR™ using this plugin. The current implementation only requires a client side browser.

Does OMAR™ comply with open standards and interfaces?

OMAR™ is an open source software project that implements most of the existing open source and geospatial interface standards. This includes OGC Web Mapping Services (WMS) and Web Feature Services (WFS).

Is OMAR™ mature and stable?

OMAR™ is being funded for operational transition, it is currently a prototype implementation with exposure to users and large data repositories. It is currently being tested in several classified and unclassified locations. The first operational baseline will be delivered to the TriWan project before he end of 2010.

What is required to install OMAR™?

Proper set up and configuration of the various components shown below along with the OMAR™ management system. The team is constantly striving to streamline the installation process, today installations typically require professional support from the development team.

Current work is focused on encapsulating the configuration in a virtual machine for Redhat or SUSE Linux based systems.

What are some of the major components bundled into OMAR™?

- Postgres/PostGIS
- Apache web server and Tomcat
- Groovy/Grails/ Java
- OpenLayers
- MapServer
- OSSIM

Is OMAR™ unclassified?

The software for OMAR™ is unclassified with one exception. The internal OSSIM libraries provide a plugin architecture that allows functionality to be added at runtime. The OSSIM team separately maintains a classified plugin to handle US National classified formats for NITF and TFRD. The rest of the OMAR™ baseline is developed in an unclassified environment using the internet.

Are there plans to interface with other data management systems?

The development team is currently considering mechanisms that allow the user to view metadata and footprints of data stored in remote systems. The user would then request staging of this remote data triggering a background process to pull the data forward, ingest it into the repository, and provide notification back to he end user. Once the source data is stored in the OMAR™ repository the user could remotely interact with it.

Does OMAR™ provide SOA compliant services?

Yes, OMAR™ uses SOAP to provide compliant services.

What are some examples of custom products that can be created with OMAR™?

- Pan sharpened multi-spectral
- Terrain shaded products
- Blue/Red change detection
- Precision terrain corrected areas of interest
- Chipping services
- Metadata query services

What is the OMAR™ development status?

OMAR™ is currently deployed on the Large Data JCTD, the Washington Innovation Center, and the CSTARs commercial ground station in Miami. The development team is currently being funded by an intelligence agency to provide development support and operational transition for the software baseline. The first operational release, version 1.8.6 will be promoted in Jan 2011. A release with enhanced

functionality, synchronizing the enhanced functionality will be available in mid 2011. A limited operational capability at the Unclassified, SIPRNET, JWICs, and SI/TK levels is planned.

Can OMAR™ support Predator video?

Yes, OMAR™ follows the Motion Imagery Standards Board (MISB) interfaces and can parse, stage and stream predator video streams. Predator feeds have an embedded KLV data stream that provides metadata on the collection. This includes the sensor and target position. Using this data the video clips are geocoded and can be queried by time and location. Internal logic in the OMAR™ system selects appropriate frames for thumbnail overviews. The clips can be downloaded or streamed back across the web to the user.

Can OMAR™ Scale?

Yes, OMAR™ is developed on laptops and typically installed on individual PCs or Servers. The Large Data JCTD is an example of an enterprise level configuration with the workload spread over several servers. The OSSIM production engine is MPI enabled for parallel processing, the software is tuned for multi-threaded access. OSSIM uses a tiled imagery structure that can sequence processing across multiple machines and processes. See the OMAR™ Scaling paper for more detail.

What are the government rights?

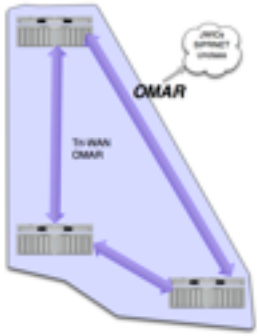
The OMAR™ solution is a trademark of RadiantBlue Technologies Inc. composed of open source software technologies. The software is delivered with an LGPL software licensing allowing the government to freely distribute and modify the software. RadiantBlue provides professional services and support to the baseline and manages the central repository. Other contractors and developers are active contributors. The core repository is located at www.ossim.org as part of the OSSIM software distribution.

Has OMAR™ been through any reviews, has it been approved for classified use?

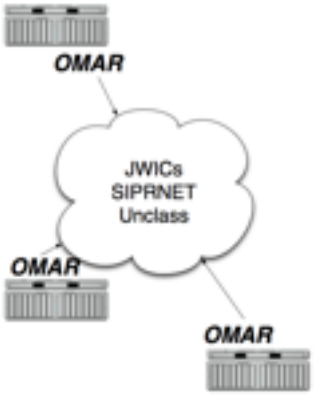
Yes, the OSSIM baseline and the OMAR™ solution are approved through the SERF process. Other evaluations include NRO AS&T classified accuracy assessments, NIMA CELTIC reviews, OSGeo Foundation incubation process and audit, RDEC-IC evaluation.

Does OMAR™ require the Large Data Infiniband WAN architecture?

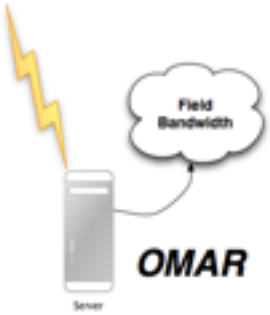
OMAR™ requires fast back end access to the data that it processes and serves. The Infiniband WAN architecture provides a geographically distributed architecture with high performance remote access. This type of infrastructure allows a single instance of OMAR™ to index and serve data from remote locations on the network. Alternatively, OMAR™ instances can be placed where the data resides with LAN file system access or local file access on the same machine. Therefore, Infiniband WAN is not required for OMAR™, but is the leading implementation for high performance remote file access. The following diagrams illustrate potential deployments for the system:



The Large Data Infiniband WAN provides a global file system and supercomputing derived distributed performance that makes remote data appear to be local. One OMAR™ instance can effectively manage multiple remote data repositories. This is the architecture used on the Large Data JCTD and the TriWan system in the laboratories.



An OMAR™ instance can be established on each data store. Future plans include adding a federated search capability to linked instances of OMAR™.



Finally, OMAR™ can simply be installed on a remote server, personal computer or laptop serving up data that is stored on the machine.

Methods are currently being investigated for allowing users to identify and stage external data sets for subsequent web based manipulation and viewing.

Version History

Version	Date	Comments
1.0	15 Feb 2009	Initial DRAFT
1.1	25 Feb 2009	Minor editing, added FAQ
1.2	7 Mar 2009	Scaling FAQ
1.3	19 May 2009	Added kml layer and date/time widget description
1.4	6 Oct 2010	Updated images, status, and FAQs

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