# Warfighter's Access to Geospatial Intelligence

Peter Winter
*Harris Corporation*

*Imagery intelligence and geospatial intelligence information have become extremely critical to U.S. warfighters under the current demands of the war against terrorism. The National Imagery and Mapping Agency's National System for Geospatial Intelligence (NSGI) provides access to such information through standard browsers into online data holdings. This article explains how the NSGI provides this high-caliber imagery intelligence and geospatial information in real time to the warfighters when they need it, wherever it is within any of the data holdings to aid in mission success.*

The demands of the war against terrorism require timely, relevant, and accurate imagery intelligence and geospatial intelligence information. The National Imagery and Mapping Agency's (NIMA) National System for Geospatial Intelligence (NSGI) provides access to such information via standard browsers into diverse data holdings containing terabytes of online imagery, imagery intelligence, and geospatial products. The NSGI enables the warfighters to locate the data they need, when they need it, wherever it is within any of the data holdings to aid in mission success.

The challenge is to provide this high caliber imagery intelligence and geospatial information in real time. There are more than 300 product types and formats of imagery, imagery intelligence, and geospatial information each with a significant rate of change per day. Also, there are thousands of image segments and intelligence reports with terabytes of online products to query.

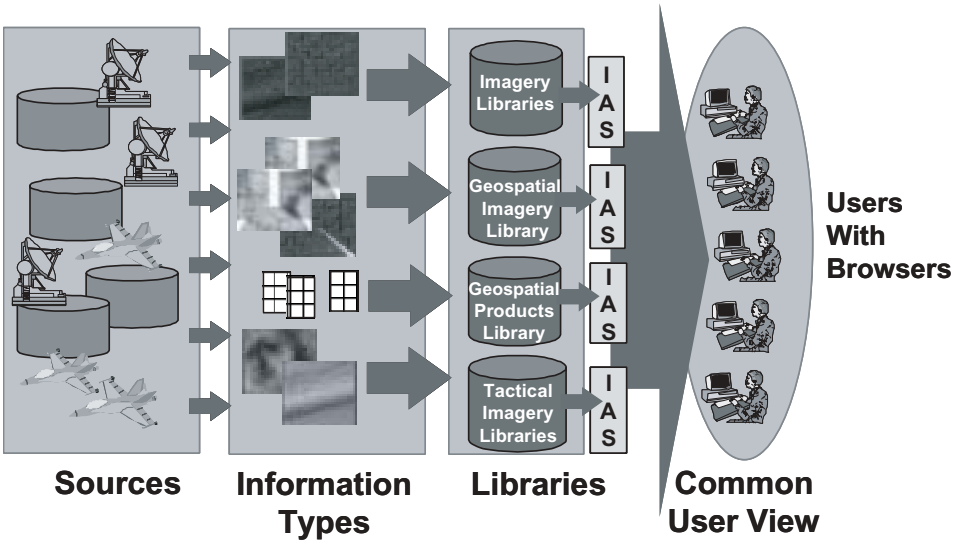
To overcome these challenges, the tool Information Access Services (IAS) provides quick access to imagery and geospatial information and products stored in many interconnected NSGI libraries around the world. Its Web-based forms provide one tool with which to discover a wealth of information. IAS makes all underlying source and information types and library locations transparent to IAS users; it sees a single Web-based set of forms. The user selects the libraries he or she wants to query, creates a query or uses an existing query, and submits the query. IAS displays thumbnails and overviews of the query results, allowing the user to order only the products of interest.

## Mission

The NSGI is a worldwide network of data collection, data holdings, and specialized analysis tool sets, all supported by a confederation of systems developed by multiple contractors located throughout the United States. To distribute the right information at the right time, the NSGI enterprise was devised as an integration of technology and collection capabilities to enable geospatial intelligence analysis on whatever source imagery, imagery intelligence, and geospatial mission-relevant data is available, all to support the warfighter's mission without information overload.

The NIMA data holdings within NSGI include imagery, imagery intelligence, and geospatial information (maps, elevation, charts, and features). NSGI supports Department of Defense (DoD) initiatives to transition from standard-scale map and chart production to easily accessible digital information that satisfies military imagery, imagery intelligence, geospatial, mapping, charting, and weapons system requirements. The NSGI's goal is to provide a common view of this disparate information as shown in Figure 1.

Figure 1: *IAS Presents the Common User View From Disparate Information Sources*




All segments within the NSGI contribute to NIMA's vision of a seamless integration of its data information resulting in a community of interoperable NIMA information libraries that provide integrated geospatial intelligence to NIMA's communities. The information libraries comprise the information heart of the NSGI enterprise. Data from multiple sources are constantly stored and cataloged in the libraries based on a common logical view of the information, which is documented in the Discovery and Retrieval Interface Data Model (D&R IDM). Developed by Harris Corporation, the D&R IDM provides the data structure to define the relationship between the stored items (imagery, imagery intelligence, and geospatial products) and metadata attributes about the stored items.

Metadata is an informational fact that describes the geospatial, imagery, or imagery intelligence product. Metadata can include information about the stored items such as currency, accuracy, data content, source information, and coverage. The physical implementation of the D&R IDM data model by all libraries provides a common set of metadata attributes for the user to query, passing metadata attributes between client and information libraries. The common set of metadata attributes provides the user a common view of the available data holdings. Queries can be constructed using metadata attributes that are valid across all libraries, and query results can be sorted by resulting attributes to facilitate analysis.

An imagery analyst (IA) uses the results of the queries to perform image exploitation, which is the extraction of information to provide knowledge – or more

specifically intelligence – about an area on the earth. Extracted information can be a description of the image contents, measurements of features of interest, comparisons of new images to previous images to determine differences to assess damage or movement, terrain analysis, or precise location of objects of interest. The time needed to precisely locate objects of interest has been significantly reduced as a result of the NSGI.

A geospatial analyst (GA) uses the results of the queries to generate digital maps and charts. The resulting geospatial products are stored in the libraries for use by others. IAS provides several other critical components of the NSGI enterprise in support of the IA and GA.

## IAS Features

The Discovery and Retrieval Client 2001 provides a common user interface of the NSGI information libraries and is composed of application programs that can be executed from a user platform that is configured to meet community standards for communications and security compliance. The Protocol Adapter is deployed with Client 2001 for access to libraries that are not compliant with the most recent specification. Profile Services provides a single point of authentication for user access and a single point of storage for user communities. Stored information such as query results and public-saved queries can be shared within the user communities.

The Client 2001 is a powerful data access and retrieval tool that operates much like a Web-based search engine for imagery and intelligence data. With Client 2001, the warfighter or intelligence analyst can quickly locate and retrieve the information needed to perform his or her mission, even across distributed and dissimilar data holdings. The NSGI data holdings seek to provide the warfighter and intelligence analyst with the most current capability to store and catalog petabytes of mission data – more data than ever before available. The IAS enables the warfighter and intelligence analyst to locate the data they need at the right time wherever it is within any of these data holdings.

Both the Client 2001 and the information libraries make it easy for users to query the NIMA holdings for existing available geospatial, imagery, and imagery intelligence products. Queries are based on geographic areas of interest, product identifiers, and generalized parametric descriptors (for example, scale, resolution, accuracy, or currency). Users can focus in on areas of interest and only retrieve information that is truly relevant to their search request. The IAS also enables users to browse online metadata, including browse views, thumbnails, and overviews of selected products; to graphically and textually view metadata; and to place orders. Users with sufficient hardware, communications bandwidth, and priority can receive orders online. Orders for physical media (maps, tapes, CD-ROMs, etc.) are delivered offline.

Those who repeatedly use the same query and result attributes and query the same library(s) can use Query Express. The Query Express page is pre-configured to show all the needed query fields with no user set-up required. It can be used as a template to be filled in with operationally significant values, or the values could have already been saved so that the user just reviews the query form and selects the submit button to initiate the query in a single button selection.

The Favorite Query option enables the user to open a query that was previously saved as a Favorite Query. This feature provides a quick method to open a frequently used query without having to access multiple pages. Favorite queries include Public Favorites (saved in a public workgroup folder) and Personal Favorites (saved to your personal Favorite Queries folder). Client 2001 provides an automatic query and order feature for advanced users that allows them to build queries that are set to automatically execute at specific times or intervals during the day and automatically forward ordered results. The results discovered are available to the user when the user logs on.

Information flows from the NIMA production systems to the information libraries for user access. IAS users also have the capability to store information in the libraries. The user-populated information is then made available to other users as value-added data for NIMA production purposes.

IAS users have unique user identifications, passwords, and account information that are specific to their use of the NIMA data and are consistent with network provider standards. The identification information, stored in Profile Services, is used to control access to library information and to provide for individual preferences and defaults. Preferences allows the user to tailor the default options that are used on many of the Client 2001 pages. After granting user access, the information libraries also control access at the data level within the library.

The Client 2001 online help capability provides NIMA users with accessible training information. It provides tutorials on how to perform specific IAS tasks and the Online Learning Capability (OLLC). The tutorials are organized by pages and topics, and can be used to search for specific topics and words. The OLLC provides sectional links within Client 2001 pages. The sectional links (*Show Me*) display relevant cue cards for critical functions, providing the user with step-by-step instructions and examples to assist him or her during task performance.

The Protocol Adapter is deployed with Client 2001 for access to libraries that are not compliant with the most recent specification. The Protocol Adapter performs an interfacing function to make non-NSGI systems available to the NSGI enterprise. Such systems may include legacy systems, prototype systems, or systems that have not maintained compliance with the NSGI interfaces. The Protocol Adapter is a software service that acts as a translator allowing Client 2001 to communicate with non-NSGI systems. To a library, the Protocol Adapter appears as a client, using that library's native client Application Program Interface. To Client 2001, the Protocol Adapter appears as a library using the NSGI standard.

## Architecture

IAS consists of thin client-server architecture operating with the client's workstation-standard Web browsers. IAS supports the DoD, federal, and internal NIMA production users. Access is via defense and intelligence networks. The architecture is scalable to support a growing user community, flexible to incorporate new user services, and extensible to exploit emerging technologies. The architecture also includes mechanisms to ensure that access to classified and sensitive data is controlled and granted only to authorized users.

Figure 2 (see page 10) depicts the IAS architecture and also the physical location of the architectural component within the NSGI enterprise. In the IAS implementation, the presentation layer follows the lightweight client model of the World Wide Web. This model eliminates the need for specialization on the user's workstation. The only element required on a user's workstation is a Web browser that complies with Hyper Text Markup Language. The interface between the application layer – Client 2001 – and the presentation layer is the Web server, which is accomplished via a commercial off-the-shelf (COTS) product called Iplanet. The application layer, or Client 2001, implements the business logic needed to present information to the user and to interpret the user's actions. The application layer constructs

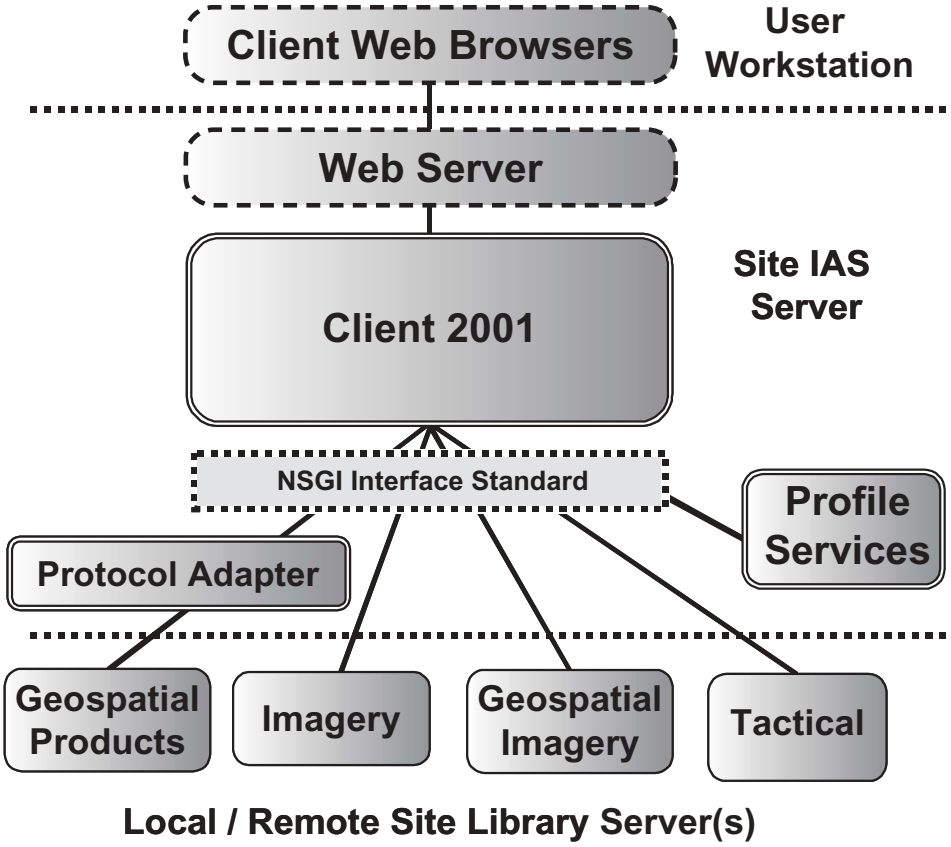



Figure 2: *The Information Access Services (IAS) Architecture*

the query as defined by the NSGI interface standard and distributes the query to the libraries, which represent the information layer of the NSGI architecture. The complexity of the IAS application layer is its interoperation with multiple instances of information layers, or libraries, providing an integrated view of information across a distributed enterprise to the user.

The NSGI interface standard documents the interfaces, data types, and error conditions that are expected to occur across the NSGI architecture. This specialized Interface Definition Language (IDL) allows clients access to data that have an association with a point or area on the earth. A NSGI-compliant library has interfaces that allow a client to search and discover information contained within the library, get details about a particular item stored in the library, and arrange for the delivery of the product.

For an enterprise as distributed as NSGI, it is necessary to define how systems can interoperate without being constrained by an operating system or language. The NSGI mandates the use of Common Object Request Broker Architecture (CORBA) middleware to provide this interoperability as part of the interface standard. CORBA is based on industry standards developed by the Object Management Group (OMG) to enable sharing of objects across layers. CORBA requires that IDL be used to specify CORBA-transported objects and interfaces and make these objects and services accessible to other CORBA objects. This allows the object's services and information to be exposed to each other and to other systems' objects across the DoD Wide Area Networks. As required by the OMG, IDL specifications are generic enough to be compiled in several different languages, including C++ and Java.

The Protocol Adapter architectural component provides access to libraries not compliant with the most recent specification. As depicted in Figure 2, the Geospatial Products Library requires a Protocol Adapter because it is a library that is operating with an old, no-longer-supported version of the NSGI Standard. The Profile Services architectural component provides services to Client 2001 as a single point of authentication for user access and a single point of storage for information about the user, user-saved queries, and query results.

## IAS Deployed Configuration

The IAS is deployed worldwide, providing information access to thousands of users. The IAS-deployed environment generally consists of a 2-CPU Sun Enterprise E4500 server with T3 disk array. The COTS items hosted on the server include Java, C++, Netscape, Solaris, IONA, RogueWave, Perl, Oracle, and iPlanet. The IAS software may also be deployed on a server as small as a laptop and up to an E6500 with 16 CPUs, depending on the deployment site workload and user base.

Most deployment sites consist of fixed location computing centers but may also include mobile environments such as ships, aircraft, and the High Mobility Multipurpose Wheeled Vehicle. Generally there is an instance of the IAS deployed with each library. These platforms exist in a secure distributed enterprise environment with users logging in from all parts of the world to obtain imagery data from the various NIMA imagery libraries. User login is through Hyper Text Transfer Protocol from a browser on their local workstation to the IAS server being accessed.

## Information Collaboration Critical to Successful Development

Information sharing and collaboration is also an important part of the development process. The IAS project has been executed with a close partnership of the customer and involvement of the user communities throughout the phases of release development. Requirements are developed in conjunction with the customer as one cohesive team and are reviewed by user representatives. In the development of requirements and design, IAS conducts daily on-site interface with the user communities providing feedback to the developers to ensure requirements and design reflect users' needs and concept of operations.

Requirements are captured and maintained in a database and linked with the following requirements analysis products: requirement interpretation, assumptions, issues, use cases, and test allocations. The project database is central to ensuring everyone involved in the development of IAS has a traceable linkage from requirements through design products to verification test procedures. IAS uses documented processes to build in quality and maintainability and to ensure completeness throughout product development and maintenance.

Adherence to the process ensures that quality is built-in not added-on. Project processes are documented in Process Directives (PD). These directives are based on Harris Government Communications Systems Division (GCSD) standards for executing projects called the division command media. The command media is tailored and elaborated for project execution. The PDs define in detail the project process throughout the

product life cycle, from requirements to product maintenance. Process is planned into a project master schedule containing detailed milestones, which provide the project management team and customer with detailed insight into the project execution.

Each function within the project acts as either a customer or a supplier. Customer-supplier checkpoints ensure the process is followed. The checkpoints and major process steps are detailed in the project milestone schedule and reported internally weekly and to the customer monthly. The process itself is open to quality improvement. PDs are sponsored and maintained by project functional groups. Improvements to process directives can be recommended by anyone on the team to the System Configuration Control Board.

The IAS project uses an Engineering Quantitative Management Plan to define the project metrics and control limits that are collected and reviewed monthly by the Project Management Team. The metrics are collected using the Harris GCSD standard metric tool (Web client/database server) [1]. The monthly review of the project metrics provides a quantitative view of the project product and processes, early visibility into possible trends, and actively identifies areas for improvement.

The IAS project collects and uses the trends of a variety of quality measurements to improve project execution and maintain or improve quality. Progress is tracked in the following areas: cost and schedule, risk assessment, resources (development environment and staffing), problems and/or defects with a product or process, system performance, stability of the degree of change, and completeness. The IAS Cost Performance Index and Schedule Performance Index remain at 1.0 or greater, demonstrating the adherence to process and good planning.

The metrics that the project monitors for adherence to plan or prediction include the following: defect work-off rate, defect discovery, defect closure status, defect severity, cost, schedule, engineering staffing, and risk assessment impact in dollars. These monthly metrics provide measure and insight into knowing how well the plan is being executed, detecting trends, and allowing decisions to be made on efforts that could be accelerated or need refocused resources to accomplish the project's goal.

## Conclusion

The NGSI has met the challenge of integrating disparate information sources and providing a common user view into the data holdings of imagery, imagery intelligence, and geospatial information. The IAS discovers the data of interest, allows the user to browse views of selected discovered products, graphically and textually views data about the products, and delivers orders of selected products either online or offline. The IAS enables warfighters to locate the data they need wherever it is within any of the data holdings at the right time. Through user feedback and process improvement, the NGSI will continue to implement user-driven enhancements to meet the evolving needs of the warfighter.◆

## Reference

1. Natwick, Gary. "Integrated Metrics for CMMI and SW-CMM." CROSSTALK 16: 5 (May 2003).

## About the Author

**Peter Winter** is the chief system engineer for the Information Access Services project. He has 25 years experience in aerospace, information processing systems, and launch control. His experience includes requirements development, designing, integrating, and testing large-scale software and hardware systems. He has Bachelor of Science and Master of Science degrees from Florida Institute of Technology.

**Harris Corporation**
**P.O. Box 37**
**Melbourne, FL 32902-0037**
**Phone: (321) 309-2442**
**E-mail: pwinter@harris.com**