SOCET GXP® v2.3

Spatially Enabled Exploitation (SEE)

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Introduction

Connectivity with vector
databases increases image
analysis capabilities

A large part of image analysis requires reviewing multiple historical reports and comparing them with new data to detect changes over time. Ordinarily, vector data is collected at the same time that initial reports are created, however the data are not saved in a format suitable for quick retrieval based on temporal and geographic attributes. To ensure accurate image alignment over time, it is critical to store data using their associated ground coordinates, resulting in "ground space graphics." The ground space graphics capability in SOCET GXP uses precise image coordinates and sensor models to reference graphics to their corresponding geographic locations. Therefore, images and graphics are always aligned properly on sequential images captured over time — regardless of sensor or software.

SOCET GXP v2.3, released in summer 2007, introduces seamless integration and synchronized viewing with Google Earth™; a direct, bidrectional link to the ESRI® geodatabase or SOCET SET® feature database for dynamic viewing and editing of feature data; and Spatially Enabled Exploitation (SEE), designed to enhance image exploitation by creating attributed ground space graphics in a connected enterprise geodatabase environment.

What is SOCET GXP?

SOCET GXP is BAE Systems' end-to-end image analysis software. Its architecture represents a radical advance in image analysis technology based on over 10 years of experience creating geospatial intelligence for image/geospatial analysts and targeteers. The software streamlines workflow processes to help users create accurate geospatial products and intelligence more rapidly and efficiently than ever before.

The new architecture enhances usability through more efficient workflows and brings together image analysis, geospatial analysis, photogrammetry, and mapping within a single product with a similar look and feel for Windows® and Solaris®. SOCET GXP is the next generation of software that supersedes VITec® ELT and VITec PC, while continuing to incorporate geospatial analysis capabilities currently present in SOCET SET®, BAE Systems' industry-leading geospatial analysis, photogrammetry and mapping package. In keeping with BAE Systems' vision that a wide range of analysis tasks are merging into a single market requiring a single product, SOCET SET's photogrammetric strength is being transferred to SOCET GXP and enhanced by SOCET GXP's fresh architecture and productive user interface.

Moreover, SOCET GXP v2.3 adds the capability to locate and preview images geospatially using Google Earth and SOCET GXP as quick visual reference and discovery tools. In addition, SOCET GXP v2.3 has tools for exporting and displaying graphics and image footprints directly into Google Earth.

The primary strength of SOCET GXP is its remarkable flexibility. With multiple windows, a broad range of user and common preferences, and the ability to share data across several different windows at one time, analysts can adapt SOCET GXP to their operational environment. These innovative concepts also bring new capabilities to image analysis, such as virtual mosaics on the fly, hyperspectral/multispectral (HSI/MSI) processing, and the Workspace Manager, the interface which drives all of this functionality.

Today's image exploitation: defining the problem

Today's image analysis workflows

To analyze events in an area of interest at a particular time, the traditional image analyst must use considerable resources to assemble a complete picture. Typical workflows involve multiple steps to compare images and identify changes in an area of interest (AOI) over a period of time. These workflows include manually searching for reports about the AOI, target, or site, and arranging them in chronological order to construct a mental picture of change. Other means of comparison to detect change may include querying a library for imagery products created in the past, though it is not easy to view multiple image products layered according to time.

The problem

The process of reading reports or viewing historical imagery products to try to assimilate critical history about an AOI has proven to be time consuming and error prone. Ordinarily, vector data is collected when initial reports are created, but not saved in a format optimized for quick retrieval based on temporal and geographic attributes.

The need

Now more than ever, there is an escalating need for analysts to obtain and exploit imagery, and create detailed reports that can be delivered to the field expediently. New intelligence disciplines use imagery in ways never seen before. But the main objective has remained constant — to give users optimal tools to view, store and exploit new images effectively.

Creating the solution

SOCET GXP v2.3 addresses the need for accurate and efficient change detection as well as direct connections to information stored in databases. A direct connection to the ESRI geodatabase or SOCET SET feature database enables analysts to take advantage of vectors for detecting change over time.

The SEE module for SOCET GXP allows the analyst to answer critical questions using spatial, attribute, and temporal queries. In addition, smart vector attribution supports external ESRI multi-user/personal databases, shapefiles and SOCET SET feature databases. Smart vectors, the key component of SEE, must meet the following criteria:
- Collected from rigorously georegistered imagery
- Collected in a ground space coordinate system
- Can be attributed with relevant data
- Populate a geodatabase or other relational data model

Storing vectors in a database offers enormous analysis benefits to analysts and mapping professionals who use traditional electronic light tables (ELTs) to compare features across a series of images. With SOCET GXP v2.3, new and historic information is at your fingertips, thus eliminating time-consuming searches for hard copy or archived reports.

Benefits of the SOCET GXP architecture

SOCET GXP is not a typical commercial-off-the-shelf ELT. Its SEE capabilities give users greater flexibility in working with their data, and its innovative features, processes, and robust architecture are transforming image analysis methodologies. The following list outlines some of SOCET GXP's key advantages over traditional software packages used for image analysis:

- Default shapefile specifications
- Ground space graphics/annotations
- Automatic connection to default databases
- Multiple windows, multiple images
- Different levels of product creation
- Animated mosaics, animation techniques across vector or feature layers
- Linked panels and creating relationships

- Auto-attribution
- Workspace Manager
- Preferences (user and common)
- Finishing Tool
- 3D flythrough
- Terrain visualization and profiling
- Templates with auto-labels
- Comparison and mosaics
- HSI/MSI

Operational aspects of SOCET GXP SEE

Overview

The following examples describe typical workflows and situations where information already exists, as well as where the user must start from scratch. As SOCET GXP is embraced by analysts, it is expected that many traditional exploitation sites will benefit from creating new, streamlined workflows, based on the wealth of functionality the software offers. SOCET GXP functionality is designed for a wide spectrum of users, including experienced GIS professionals and analysts looking for more efficient ways to complete projects and missions.

The most basic image analysis workflows are outlined below:

Start without previous data

1. Load and display an image to exploit in SOCET GXP
2. Create a new feature database, geodatabase or connect to existing databases
3. Set the active vector graphic type (feature class) to collect
4. Create a graphic (feature) of the selected type
5. Set attributes for the new graphic; review auto attributed values
6. Repeat steps 4 and 5 until all desired vector graphics are created
7. Export the attributed vector graphics to a shapefile or other supported format

Start with previous data

1. Load and display an image to exploit in SOCET GXP
2. Connect to a database
3. Query for vector data from the database based on the image footprint and time range; set query display groups to animate
4. View vector graphics divided into separate layers based on time period
5. Using the Flicker/Animation toolbar, page through layers to view changes that have occurred over time
6. Open the attributes dialog for graphics of interest to obtain additional information, such as textual description and date attributes
7. Edit/create graphics to document the current state
8. Edit attributes associated with the graphic type
9. Generate a report documenting the current status of the site and significant changes; reports can be saved in PowerPoint® and NITF formats, and animated layers can be saved as animated GIF, GIF or AVI files
10. Save the new graphics to the database

Database connection

Database selection

In SOCET GXP, the user can connect to an existing ESRI geodatabase (created previously using external ArcGIS® tools), or to an existing SOCET SET feature database. If connecting to an existing database, SOCET GXP can read the schema automatically. If a new shapefile or SOCET SET feature database is created, SOCET GXP will provide a database specification editor for the user to create custom databases. A number of predefined auto-text labels are provided for auto-attribution. In addition, custom auto-text labels used for attribution can be defined using the Preferences window. These are the same auto-labels used for product templates.

SOCET GXP provides a variety of default specifications, however, the user can easily add feature layers or attributes to a shapefile or SOCET GXP database during the exploitation process.

A default specification for shapefiles can be set by the user in the SOCET GXP Preferences. GXP also provides the capability to load a default feature database automatically into the workspace.

Database load

The Feature Database Connect window is accessible from the Workspace Manager or the Panel Data Manager (See Figure 1). To begin, load a data source into the workspace. The data source will be listed in the Workspace Manager Data View tree after loading.
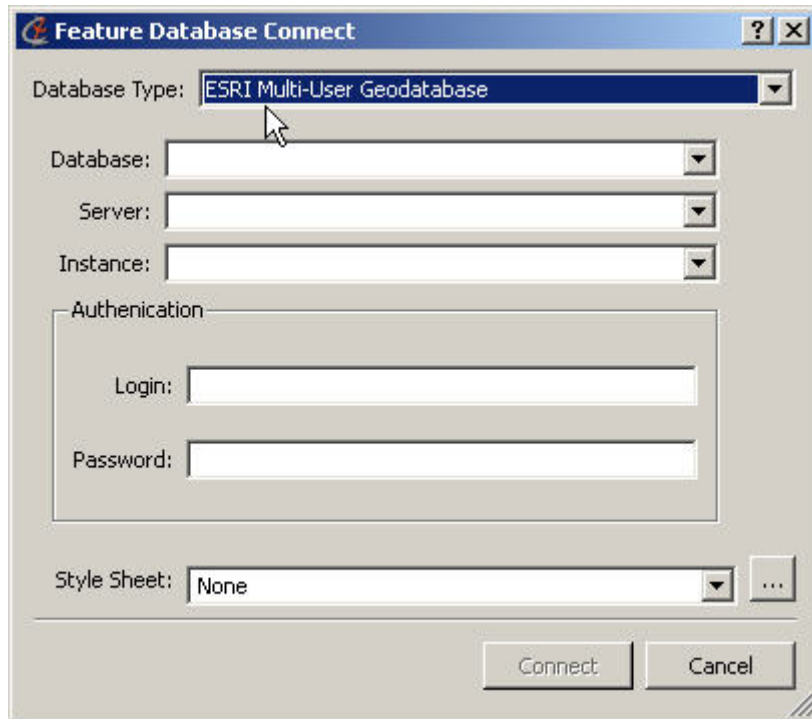
Figure 1: Feature Database Connect dialog

Enter the name of the database and the server name. If authentication is required the user can input their login and password.
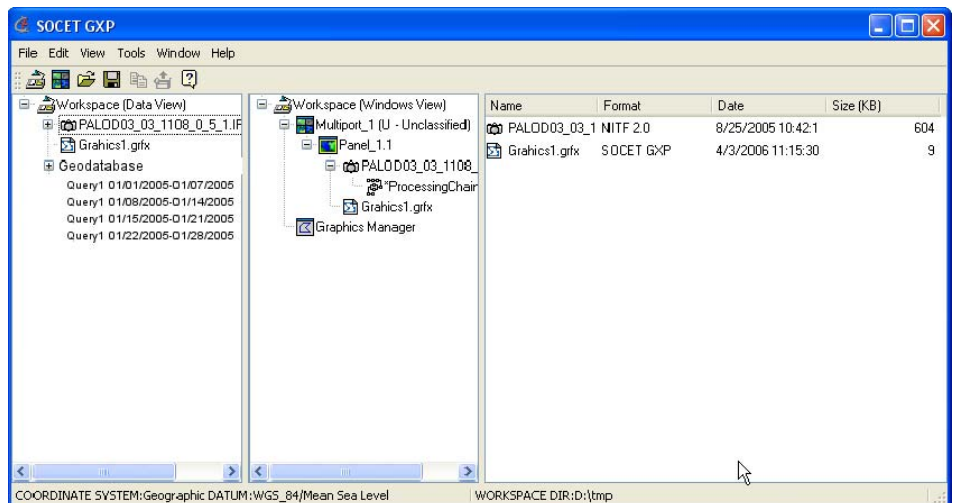

Figure 2: Sample geodatabase Data View node and time-based query layers

Vector data query

The Vector Data Query window, accessible from the Workspace Manager and labeled Feature Query - Panel_1.1 in the following illustration, is used to define queries for retrieving vector data from a database. The results of the query will be loaded into SOCET GXP as a display layer, which will be named based on the query name provided by the user. The Query Name drop-down list box contains a list of queries used.

The Query Source drop-down list box is used to select the database to query. The list contains all of the databases that have been loaded into the workspace.
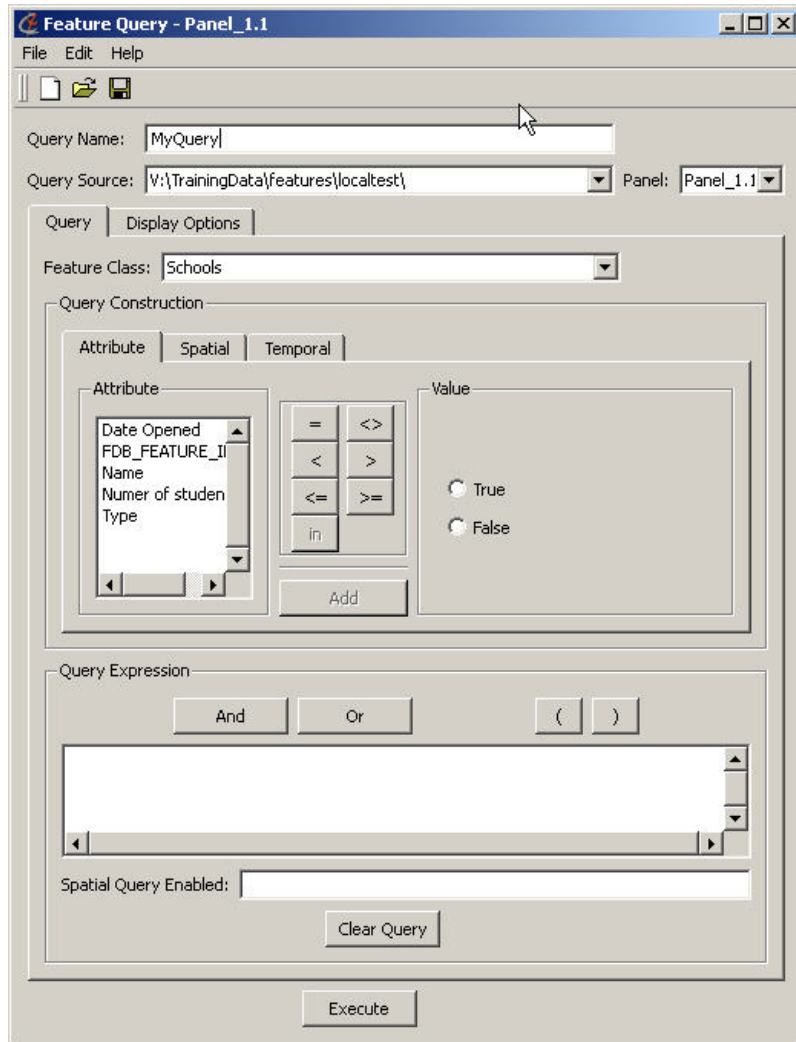
Figure 3: Attribute tab

The Query Construction section has three tabs. The Attribute (attribute parameters) tab is used to define the type of vector data to retrieve. The query can also be refined to select data based on attribute values. The intent is to keep the interface simple for analysts to use.
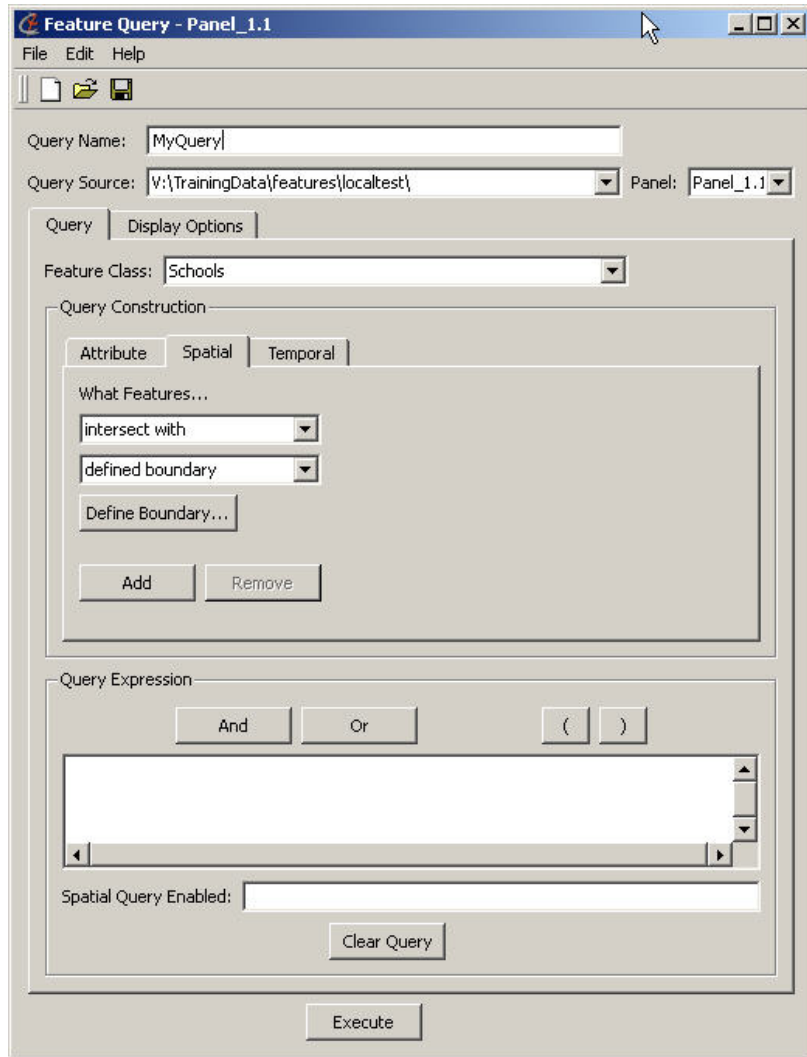
Figure 4: Spatial tab

The Spatial (spatial parameters) tab is used to specify the geographic region for which to retrieve vector data. The user can draw the desired region on an image or SOCET GXP virtual mosaic, use the visible panel region, use the footprint of the images in the active panel, or type in the bounding box manually. If the input fields are empty then a geographic bounding box is not used in the query.

Feature graphics management

Feature graphics that are displayed in a Multiport are managed using the Panel Data Manager, which is accessible from the Multiport. From this window, the user can launch new queries or launch the Feature Attributes window to add or edit features.

The Panel Data Manager window provides access to the feature contents displayed in a specified Multiport. The Active Panel drop-down menu is used to select a Multiport panel. This is required functionality because of SOCET GXP's capability to display multiple images and other types of data at the same time within separate panels. The Panel Data Manager displays two panes or views, Contents View and Display View.

The Contents View displays nodes for all feature database connections and their feature classes loaded in the active Multiport panel. The Contents View displays a tree-view hierarchy with the active Multiport panel representing the primary node, or trunk, and additional branches of the tree representing feature database connections. Each feature database connection node has a branch containing its feature class nodes. Connection and class nodes can be dragged and dropped to a particular position in the Display View tree. If there are no feature databases loaded, then only the Display View shows in the Panel Data Manager.

The Display View contains layers to control visibility, draw order, and animation frames in the active Multiport panel. A layer can be an annotation graphics file, terrain data, image, or feature data. The Display View contains a tree-view of the active Multiport panel. Displayed with each node in the tree, except the panel node, is a show/hide checkbox. Checking a tree node displays the layer, and deselecting it hides the layer in the active Multiport panel.

The nodes in the Contents View and the Display View can be selected with the right mouse button to gain access to related functionality through the shortcut menu. The Panel Data Manager main menu items provide access to additional functionality.
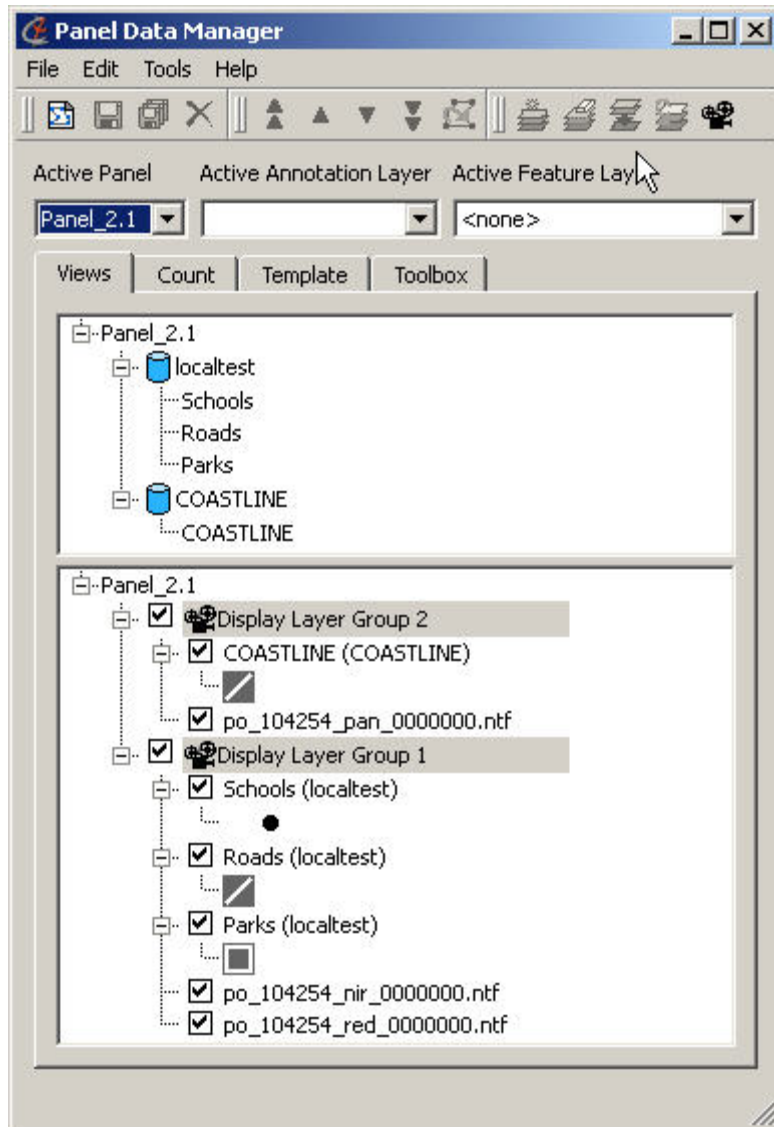
Figure 5: Panel Data Manager window

One of the most valuable aspects of the SEE functionality in SOCET GXP is the capability to attribute features directly without using another software package. Populating attributes of a new feature or editing attributes of an existing feature is accomplished through the Feature Attributes window.

The Feature Attributes window offers two options. If the user right-clicks on a single feature in the Multiport panel and selects **Attributes…** from the shortcut menu, the following window appears. The window is populated with attributes of the selected feature graphic.
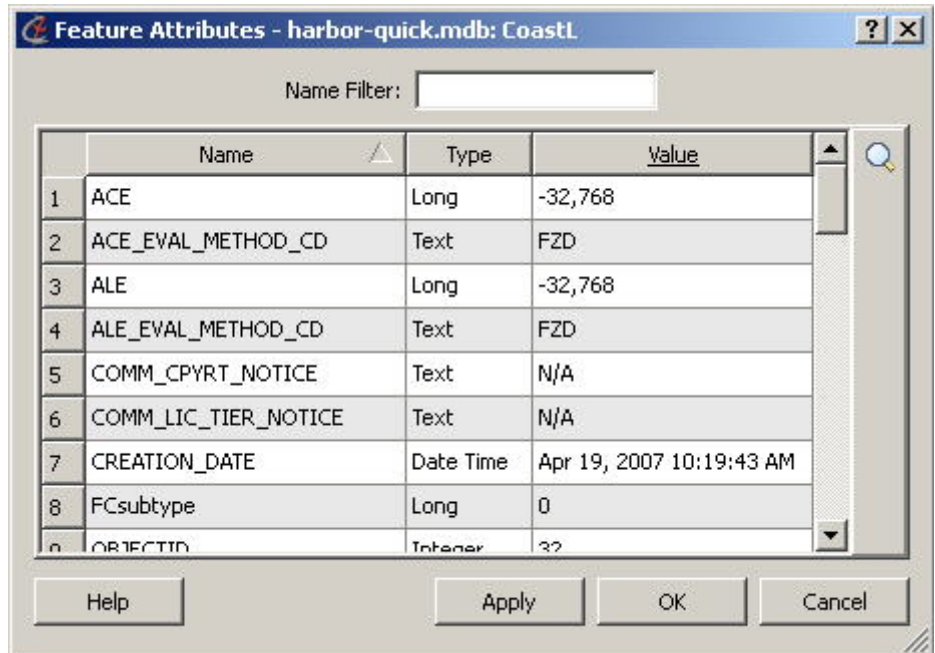
Figure 6: Feature Attributes window — attributes for a single feature graphic

Alternatively, the Feature Attributes window can be accessed from the Panel Data Manager using the right mouse button to select the feature class node in Display View. Select **Edit Feature Attributes...** from the shortcut menu. The window is populated with attributes for all of the features in the selected class. Column headers that are underlined indicate that cells in that column can be edited.
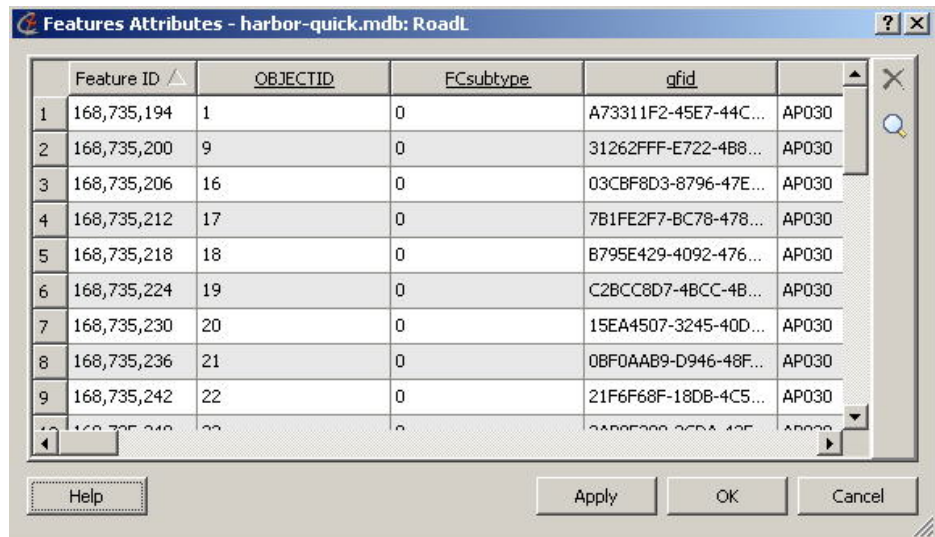

Figure 7: Feature Attributes window — attributes for all features in class

The Feature Attributes window displays a table with a row for each feature and a column for each attribute. The user can modify and edit the feature attributes table. The rows can be sorted in ascending/descending order by selecting the column header. Column headers that are underlined indicate that cells in that column can be edited. The user can double-click on the cell or use a shortcut menu to modify the text. Selecting a row highlights the feature in the Multiport panel. Changes are not applied to the feature's attributes until the **Apply** or **OK** button is selected.

When selecting a different feature class, the window is updated with the current feature class and the table is populated again. However, before re-populating, if any previous attributes have been modified, the user is asked to save the changes. If the new selection list does not contain a feature class, then the window is closed.

The following figure shows an image with features applied.
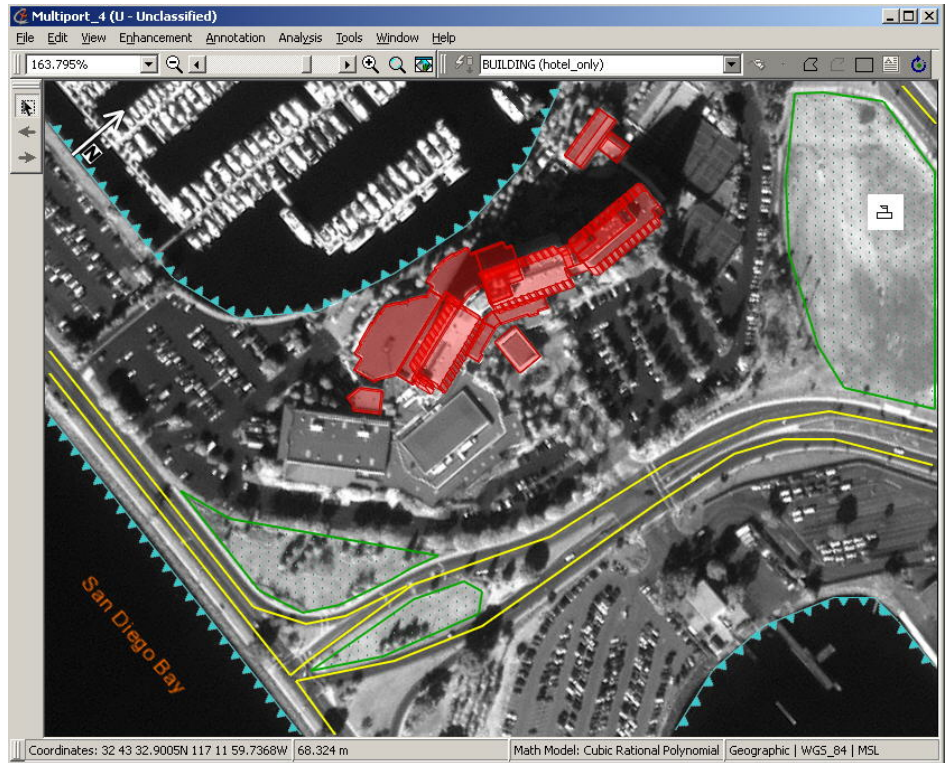
Figure 8: Multiport panel with features applied

What this means to the SOCET GXP user

The benefits of using SEE in SOCET GXP

The dilemma of finding solutions for streamlining the image analysis process to increase accuracy and efficiency has been discussed for many years. SOCET GXP v2.3 functionality includes a capability to query and manipulate vector data superimposed on current imagery quickly. BAE Systems strives to offer advanced products that surpass the capabilities available today, and to demonstrate to its users how changing the way they work and incorporating groundbreaking technology can benefit the intelligence community as a whole.

The SOCET GXP architecture was created with the understanding that users today work with multiple images, and must have the capability to view more than one or two images simultaneously. Moreover, they need the flexibility to link images together or apply vector data on more than one image. The SOCET GXP architecture offers capabilities to query for, create, display, and save vectors to a database, which empowers users to build new workflows designed around their requirements. Since users need to display multiple images, it is possible for vectors retrieved from a database to be applied to different images at the same time, substantially reducing the time spent loading data.

The SOCET GXP v2.3 SEE implementation can generate the same type of image products as in the past. In fact, users benefit from additional resources such as quick template functionality, flexible drawing tools, and database storage capabilities. When users receive new images of the same location, a simple time-based query displays previous image products with new ones to detect changes, without the need to view multiple image products from different sources. The analyst no longer has to search for historical data such as textual reports to determine what has changed and when. The use of vector data retrieved from a database, to which every analyst has access, will streamline the analysis process, allowing the analyst to concentrate on what is most important — identifying significant items of interest.

FOR MORE INFORMATION CONTACT:

Americas
Telephone (800) 316-9643 or (703) 668-4385
Fax (703) 668-4381
Email socetgxp.sales@baesystems.com

Europe, Middle East and Africa
Telephone +44 1223 370023
Fax +44 1223 370040
Email socetgxp.emea.sales@baesystems.com

Asia-Pacific
Telephone +61 2 6273 0111
Fax +61 2 6273 0368
Email socetgxp.asia.sales@baesystems.com

www.baesystems.com/gxp