In the past few decades, the GIS industry has feasted on a proliferation of specialty software packages designed to accomplish every task imaginable to increase productivity. Technology has taken the tradecraft from tenured professionals, leaving them little choice but to become proficient with a myriad of computer-based tools and devices to stay competitive. With so many options, new paradigms to digest, and long hours logged to learn new products, it was only a matter of time until a next-generation software package would make its debut, eclipsing those that came before it to introduce a new way of working with geospatial data: SOCET GXP v3.0.

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**SOCET GXP v3.0**

Geospatial-intelligence Software

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**eXtreme Analysis with SOCET GXP v3.0**

BAE Systems’ SOCET GXP v3.0 software represents the convergence of image analysis and geospatial analysis in one software package for diverse uses — from finding beach landing sites for combat troops to helping land the Mars Rover. It moves away from a task-based model that requires individual specialty products to a comprehensive solution that facilitates the completion of end-to-end workflows. The company calls this fusion of functionality eXtreme Analysis, or XA. XA empowers individuals to satisfy multiple analysis and mapping tasks quickly and efficiently, reducing the dependency on multiple tools. SOCET GXP makes it possible for a broad range of personnel, trained and untrained, military and civilian, to use the same product to build, view, and analyze geospatial-intelligence information. It consolidates image exploitation, geospatial production, and mapping tasks, and establishes the basis for future feature extraction and analysis.

A customizable interface and extensive network of user-defined preferences allow individuals and system administrators to organize the desktop environment according to specific workflows. Users can connect to Google Earth and the ESRI geodatabase to create, store, and share geographic information, and to export geographically-rich image data and finished map products such as PowerPoint slides and GeoPDF files directly from the SOCET GXP workspace. The GeoPDF format, gaining popularity in the GIS and geospatial-intelligence communities, is an invaluable resource. Anyone with access to the Adobe Reader can view, mark up, or configure geographic attributes contained in an image or map generated with SOCET GXP from a desktop computer. The PDF document maintains predominant features and coordinates, yet compresses the file to a size suitable for transmission via email, portable drive or shared network. With this technology, customers can share geospatial assets with users in the field, regardless of their physical location and technology, facilitating interoperability and collaboration.

SOCET GXP is designed to simplify workflows and make the software easy to use for new and veteran users. Tools for image analysis, 3D simulation, and targeting are particularly helpful for homeland defense or military intelligence missions, while pushbutton functionality for orthorectification, triangulation, mosaicking, and digital terrain model generation benefits geospatial analysts and photogrammetrists.

The software processes data from a variety of image sources and creates products that can be compressed and saved in multiple formats. Data and reports can be e-mailed and accessed from mobile laptop computers, relay stations, and ground control centers. Products generated from SOCET GXP include topographic image maps, 3D models with realistic geographic context, and target charts.

Another advantage of SOCET GXP that is critical to many customers is that it offers the same appearance, performance, user experience, and software baseline for both UNIX and Windows, for ease of use among multiple workstations. By providing all of the required functionality in one product with a single user interface, BAE Systems empowers organizations to consolidate resources and increase productivity. The SOCET GXP architecture is scalable and highly
configurable so that customers can buy specific functionality to meet their requirements. While a particular organization may have several configurations or software bundles in place, all of the software functions with the same underlying architecture and user interface. The single user interface eliminates the problem encountered by customers today, who have to use several different software packages to accomplish their tasks. Some of them use as many as six packages, often unrelated or loosely integrated, and cannot possibly be trained well enough on each one to take full advantage of its capabilities. By minimizing the number of software packages required, SOCET GXP users can streamline training, reduce integration and O&M costs, simplify licensing and customer support, and increase productivity.

The Transformation of an Industry
Several years ago, BAE Systems observed a transformation in the geospatial-intelligence and GIS disciplines. Image analysts who traditionally used electronic light tables for analyzing satellite and aerial images needed a user-friendly software application for extracting accurate geospatial information, while photogrammetrists, cartographers, and geospatial production teams were looking for an image-analysis tool to simplify rigorous processing tasks, and improve productivity. With successful software products in both markets, the company forged ahead to develop a comprehensive, scalable application to satisfy image analysis and geospatial production requirements.

At that time, BAE Systems offered two distinct software products — the VITec electronic light table (VITec ELT), a UNIX-based system for image viewing, analysis, and exploitation, and SOCET SET, a versatile photogrammetry suite for precision 3D mapping, feature collection, and digital terrain generation. The close association BAE Systems had with VITec ELT and SOCET SET was instrumental in understanding the needs of each audience. In 2004, the vision became a reality with the release of SOCET GXP, a next-generation image analysis and geospatial production application. SOCET SET's photogrammetric strengths are being transferred to SOCET GXP and enhanced by SOCET GXP's fresh architecture and productive user interface. The combined strengths of VITec ELT and SOCET SET are the basis for Extreme Analysis. Rigorous sensor modeling, a hallmark of the SOCET SET application, is available in SOCET GXP, which makes it possible for users to combine imagery from several sensors — commercial, defense, airborne, and customer-defined plug-in sensor models — in one project for comprehensive analysis. With the implementation of a new graphical user interface, most tasks are initiated with a few mouse-clicks, and the workspace can be organized according to individual or organizational preferences for maximum ease of use.

**SOCET GXP — a Closer Look**
SOCET GXP uses imagery from numerous image sources to identify and analyze ground features. Analysts can automatically measure, annotate, store, and retrieve the features in a series of images to expedite geospatial production, image analysis, and map creation. The information is used to monitor changes over time, aid in disaster relief and recovery, develop transportation, utilities and communications networks, coordinate surveillance missions, and designate troop maneuvers. In field or crisis situations, first responders and deployed forces depend on up-to-the-minute information to make critical decisions. Real-time image analysis, automated geospatial production, mapping, and 3D visualization can be accomplished using SOCET GXP's pushbutton functionality. Sophisticated new algorithms, developed by BAE Systems' research and development teams, automate complex tasks. Typically, these end-to-end workflows require several specialty packages and a series of manual operations. However, SOCET GXP manages tedious image processing steps automatically. The rigorous mathematical calculations are executed behind the scenes, freeing users to focus on other tasks.

**User Interface**
SOCET GXP v3.0 replaces a traditional menu and toolbar system with The Ribbon, the main component of a new user interface that organizes tools by tabs that correspond to each task. The Ribbon displays tools when needed, and hides them when not in use to avoid cluttering the desktop environment. It uses contextualization to simplify the number of choices available at any given time. The implementation of this flexible interface is based on the Microsoft Office Fluent user interface, designed to save time, help individuals access all functionality available in an application, and provide a scalable platform to build on for the future.

SOCET GXP v3.0 is the first commercial, end-to-end geospatial information management application to implement the Microsoft Office Fluent user interface. Users who have tested the software like the increased flexibility, workspace customization, and accessibility to SOCET GXP's versatile toolset.

Microsoft invested more than three years of research and development and millions of dollars in the new user interface design. They analyzed over 3 billion data sessions collected from Microsoft Office software users; conducted surveys and usability studies; built hundreds of conceptual prototypes; and experimented with new designs through customer site deployments and beta programs. Today, most of the software Microsoft developed...
ordinarily, vector data is collected when text-
variety of ways. These smart vectors can then be queried in a
composition directly in an ESRI geodatabase. Analysts use this module to identify
reports. Analysts use this module to identify
time-consuming searches for hard-copy
uses familiar tools and universal file formats
storage and management framework. The
Systems Research Institute’s common data
the ESRI geodatabase, the Environmental
SOCET GXP provides a direct connection to
large-scale applications.

**XA and Change Detection**

With eXtreme Analysis tools for detecting changes from one day to the next, analysts
can anticipate conditions such as rough ter-
control over time, it is crit-
geo-space graphics — using
coordinate system as previous images, so fresh
information can be exploited in time series analyses with earlier collections. This func-
tionality makes SOCET GXP unique in the mar-
place.

**ESRI Database Connectivity**

SOCET GXP provides a direct connection to the ESRI geodatabase, the Environmental Systems Research Institute’s common data storage and management framework. The Spatially Enabled Exploitation add-on module uses familiar tools and universal file formats to edit, store, and retrieve information, avoiding time-consuming searches for hard-copy reports. Analysts use this module to identify an object, define, annotate, and classify that object, and then store a record of its pixel composition directly in an ESRI geodatabase. These smart vectors can then be queried in a variety of ways.

Ordinarily, vector data is collected when text-
based reports are created, but not saved in a
format that facilitates quick retrieval based on
temporal and geographic attributes. To ensure
accurate image alignment over time, it is crit-
ical to store data using ground coordinates, resulting in ground space graphics — using
precise image coordinates and sensor mod-
els to reference graphics to their correspond-
ing geographic locations. Therefore, graphics are always aligned properly on sequential
images captured over time. As new imagery
arrives, it can be registered in the same coordi-
nate system as previous images, so fresh
information can be exploited in time series analyses with earlier collections. This func-
tionality makes SOCET GXP unique in the mar-
ketplace.

Other advantages of direct SOCET GXP and ESRI geodatabase connectivity include remote access by multiple users, versioning, and
security. The availability of this online connection to a geospatial database within a soft-
ware environment provides analysts with a wide range of powerful tools including coordi-
nate systems and sensor models, image
import, and photogrammetric functionality
such as triangulation, elevation extraction,
ortho-rectification, and visualisation. Con-
nection with the database allows users to work with data over secure networks for accurate,
timely analysis.

**Google Earth**

Google Earth is a popular 3D color visualiza-
tion and discovery tool used in tandem with
SOCET GXP to aid change detection and sit-
tuational awareness. Google Earth synchron-
zines with the location of an image open in the
SOCET GXP application to provide geospa-
tial context. Alternating between the applica-
tions, views update dynamically. Large geo-
graphic regions are scanned for an area of
interest or specific location. Next, annotations, features, and graphics are added to form the
basis of an intelligence report. The informa-
tion can be exported as an image footprint
for Google Earth, a PowerPoint slide, or a
GeoPDF file.

**Automated Photogrammetry**

A digital terrain model (DTM) is one of the
most important 3D geospatial data types. One
of the key automation technologies in soft-
copy photogrammetry is to generate a DTM
automatically. The most reliable and widely
used algorithm for DTM generation is norma-
ized image correlation. However, this algo-
rithm has limitations when dealing with ele-
vation discontinuities such as building edges,
because it is based on the assumption that
elevation within a window rarely changes.

SOCET GXP includes Next-Generation
Automatic Terrain Extraction (NGATE) function-
ality, an image processing innovation devel-
oped by BAE Systems that can decrease man-
ual editing time significantly. NGATE uses a
hybrid matching process to create precise ele-
vation data for 3D terrain and surface mod-
els. Its unique combination of image match-
ing techniques offer clear improvements over
earlier digital photogrammetric mapping pro-
cedures for generating elevation data from
imagery.

NGATE is particularly useful for mapping
urban areas, large geographic landscapes,
mountainous or rough terrain, and areas with
little contrast, such as road surfaces on large
scale imagery and vast deserts.

In addition to tools for terrain model genera-
tion, pushbutton triangulation, and mosaick-
ing, SOCET GXP has an automated process for
orthorectification. The Ortho On-the-Fly tool
orthorectifies and mosaics raw images in real
time to produce continuous, accurate imagery
of an expansive area. The results can be used
for immediate product generation or future
analyses. Orthorectification removes geo-
metric errors or displacements in an image caused
by the orientation of the sensor or variations
in the terrain elevation. The result has a con-
sistent scale, allowing accurate measurements of
position, distance and direction. Ortho On-
the-Fly enables first responders and analysts in
the field to view and analyze orthorectified
imagery without delay, or revert to the raw
data. Raw images are available for extended
processing such as automatic terrain genera-
For individuals with little or no photogrammetry or image analysis experience, SOCET GXP offers a wide range of analysis and production capabilities wrapped in a flexible user interface that provides visual cues for quick ramp up.

Conclusion

BAE Systems owes much of its success to its customers. Year-after-year, feedback is gathered, evaluated, and implemented in software updates. Annual user conferences and beta testing programs provide a collaborative forum for engineers and product development teams to meet with users to gain a realistic understanding of workflows and to test usability. It is equally important to document feedback from troops on the front lines. Deployed forces using SOCET GXP in the operational environment often rotate in and out frequently and different people are doing the work from one week to the next. This is also true of large organizations that employ shift workers. Being aware of these conditions is helpful in BAE Systems’ efforts in developing a product that is relevant and useful to a diverse user community.

For individuals with little or no photogrammetry or image analysis experience, SOCET GXP offers a wide range of analysis and production capabilities wrapped in a flexible user interface that provides visual cues for quick ramp up. Novice users can learn the basics, and continually build on prior knowledge as time permits. On the other hand, skilled professionals are pleased with the depth of functionality and user preferences that can be tailored to specific workflows. Add-on modules are available for specialized functionality.

As an early adopter of the Microsoft Office Fluent user interface technology in its SOCET GXP software applica-