BAE SYSTEMS

# Developing a multi-INT common intelligence picture through the rapid visualisation of data

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Geospatial eXploitation Products™

Geospatial solutions to ensure a safer world.

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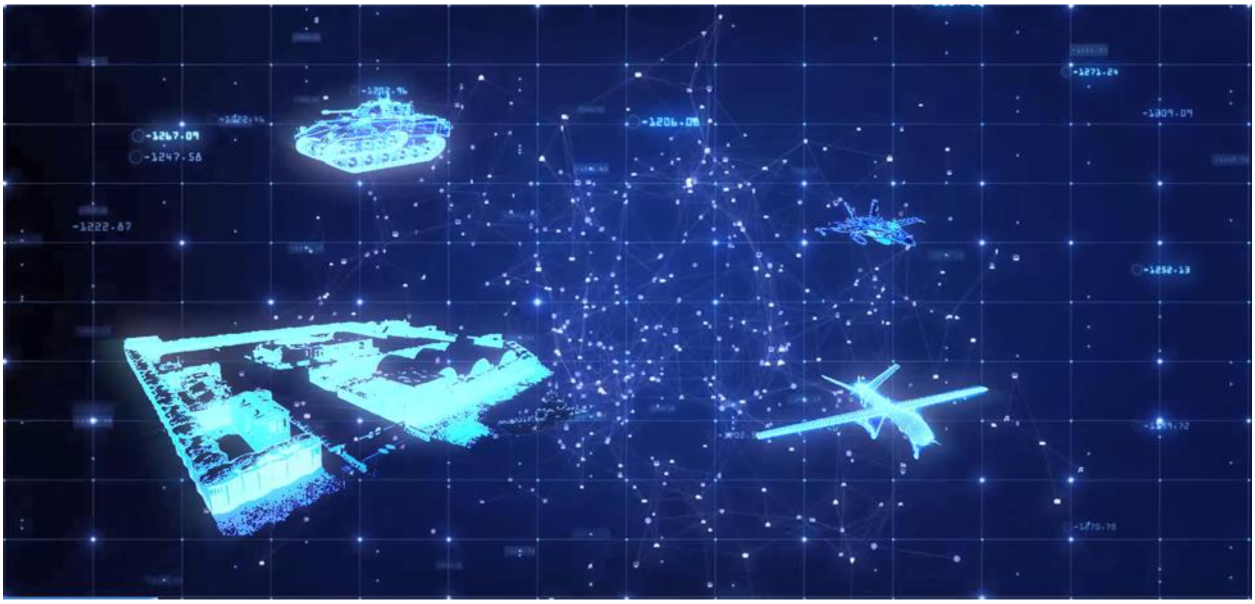
## The challenge of an expanding data universe

From command centers to the combat field, advanced military operations are rapidly evolving as a vast network of sensors, wearables, and Internet of Things (IoT) devices increasingly connect ships, planes, tanks, drones, operating bases and individual soldiers across a cohesive, worldwide system. With this rapidly expanding data universe fueled by an increasing velocity of information streaming from disparate sources, how can your enterprise accurately interpret all of this information and uncover key insights?



## Who is affected by this problem?

All source intelligence personnel, including geospatial and image/video analysts, are typically charged with managing and interpreting this exponential increase in sensor data volume. These individuals gather raw intelligence data (including information on potential threats, persons of interest, and strategic targets), assess the information, and prepare intelligence reports in order to provide mission guidance for critical decision makers. Often supporting military and defence operations, to include counterterroism and insurgency, all-source analysts also work for private contractors, and different aspects of law enforcement and private security, supporting strategic operations around the world.

## Interpreting a high volume of data from disparate sources

Breaking down the data silo barriers and connecting data together is the first step in addressing this complex problem. By combining an efficient search engine with an innovative graph database, data sources of all types can be effectively unified by leveraging existing data infrastructure instead of duplicating data, visualizing the connected data, and bringing it together in a coherent and meaningful manner. Search and discovery layers deliver relevant information in real-time, supported by a graph database which links various data types to deliver a fused view of information across multiple sensors and systems.

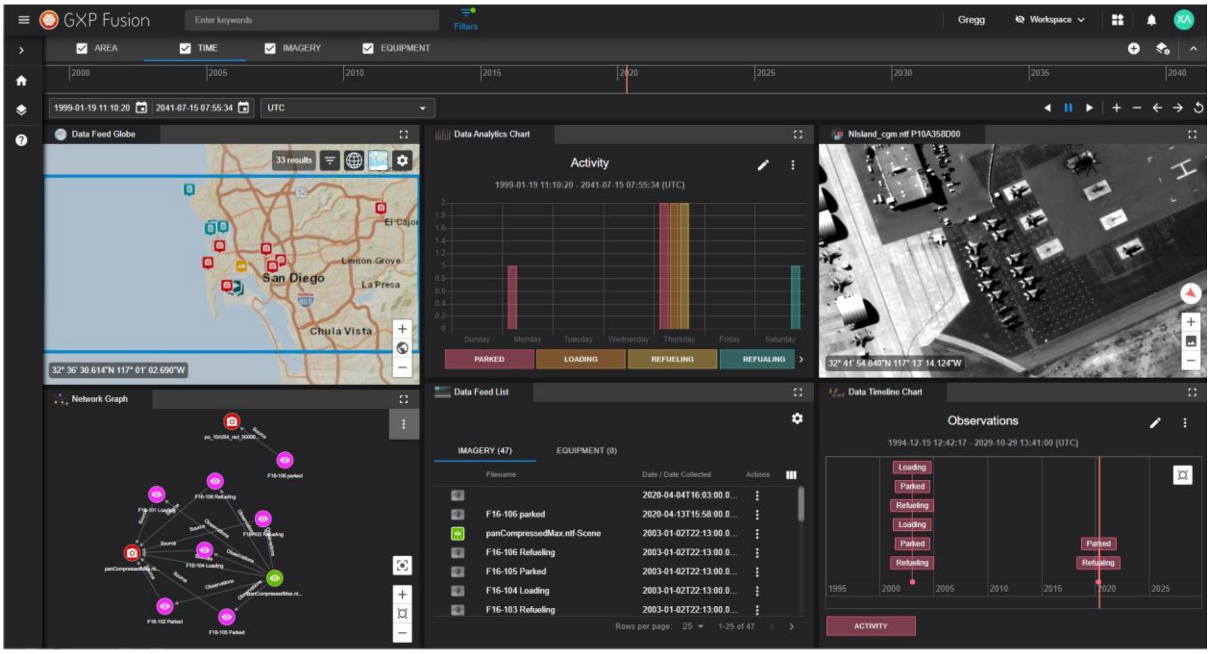
To orchestrate this process, GXP™ has developed a lightweight programmable, rules-based workflow engine utilizing industry-leading capabilities for Natural Language Processing (NLP), image based object detection, and video based Moving Target Indicators (MTI). This engine, in combination with an advanced alerting and notification mechanism, ensures that both analysts and supervisors understand what work is in the queue and the status of tasking as it flows through the system.

Visualizing the data is key to making the leap from observation to decision making. To this end, a multi-panel viewer allows users to fuse Multi-INT data in a meaningful way. For example, if a user selects a location name in a document the map pans to that location and the network graph adjusts to highlight the name of the selected location. Time and location-based filters ensure the user is focused on the correct time and place. Other visualization components include an analytic chart for summarizing discrete or continuous data, and a timeline chart for looking at the chronological sequence of events.

# A new technology enabling rapid data interpretation

Powered by the GXP Xplorer® Platform, GXP Fusion™ leverages existing data infrastructures to deliver actionable insights for analysts and soldiers through a unified view of information across sensors and systems.

With an enhanced dashboard, GXP Fusion offers an immersive visualization experience enabling rapid interpretation of connected information from a variety of sources, while delivering real-time situational awareness. Through the discovery of patterns, anomalies, and hidden relationships, analysts are provided with a 360-degree view of their data which can be easily shared with all stakeholders.




*GXP Fusion configurable display.*

GXP Fusion combines multiple machine learning (ML) and artificial intelligence (AI) algorithms to enrich data, reduce noise, and help analysts focus on the most critical insights. Object detection from imagery, moving target extraction from full motion video, and entity/relationship extraction from documents are all automated processes within this solution.

Seamlessly orchestrating multiple tasks and processes, GXP Fusion enables efficient collaboration between human and machine, enabling analysts to anticipate future events and empowering decision-makers with critical information. Augmented with ML and AI technology, GXP Fusion enables users to work smarter and faster, without disrupting current workflows.

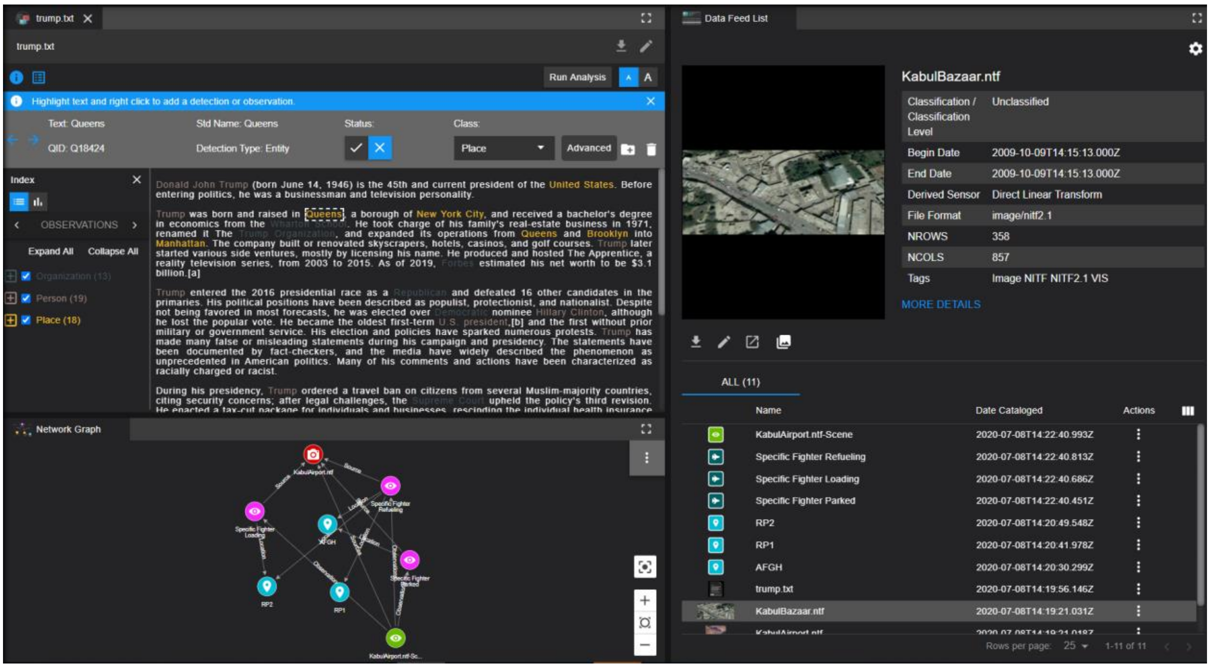
## Addressing the remaining challenges

There are numerous third-party tools available for this new technology, and each one has unique capabilities that may be more desirable depending on the particular mission at hand. By utilizing a component-based plug-in architecture, tools can be rapidly changed out based on varying user requirements. This has proven to be critical for utilizing best fit for NLP and image-based object detection.

Developing workflows for use with the workflow engine is critical, however, allowing users to modify them using the workflow Business Process Execution Language (BPEL) interface can be extremely complex and overburdening. This issue has been solved through the development of predefined Processing, Exploitation, and Dissemination (PED) workflows and an onsite professional service support mechanism for developing customer specific workflows.

Prior to running a ML algorithm, the user typically needs to setup a custom ontology which allows for proper categorization of the automatically collected entities. Providing an import mechanism for reading in these ontologies, along with tools for manually mapping attributes, is critical to maintaining the velocity of automatically collected information. Once this ontology is established, manual collection of information can utilize this same schema. The user interface for making manual collection automatically configures itself to contain only fields that are relevant to the type of date collected (e.g., aircraft will only contain attributes for wingspan, tail number, make and model).

Machine learning is the key to a quick decision-making cycle, but often the raw output needs review and verification. Additionally, the initial training and reinforcement learning process requires users with a unique skill set. To overcome these issues, users require a robust set of Quality Assurance (QA) and Quality Control (QC) tools because they need a results review interface to verify ML detections. Furthermore, the *interface needs to enable a simple* fusion of information from different data sources. For example, the Network Graph link information may tell the user that a particular document does not make sense, and could likely be providing false information. Finally, the QA/QC results feed the reinforcement-learning process and domain experts will need an easy way to update and train the system.




*Machine learning with human in the loop.*

The effects of false information or fake news can contaminate the analysis of Open Source Intelligence (OSINT) data. The analyst needs a simple method for rejecting the contribution of this false information to the decision cycle. By separating out the various source of information and allowing the user to toggle on/off their varying contributions, the analyst can quickly see the effects. Only when quality information is fed into the system can accurate analysis be made. This is especially true when visualizing connection information in a network graph.

Dissemination of the analysis is the last step in the PED process. Results are made available in both a graphical and textual format. For example, results from the network graph are exported in common graph formats such as GraphML so that they can be viewed in other third-party graph viewing tools. The results from analytic and timeline charts are exported to .csv or .xlsx formats and are viewable in spreadsheet applications. Raw data output is also useful for retaining the meaningful attribute information. A summary report provides a customizable view containing analysts' recommendations and graphical and textual backup material in a single PDF document.

Forensic analysis is also useful for predicting the future. By archiving a time-stamped version of the analysis results with associated linked information, user information, reference information, dashboard configurations, and filter setting, a user can use the Time Slider to go back and watch how an event unfolded. Additionally, by including the workflow information, analysis can provide productivity metrics (e.g. how long an analyst takes to complete a task).

## Conclusion

The analysis of Multi-INT data is a complex process that requires fusing data from disparate sources, viewing the relationships between data, analyzing patterns and predicting outcomes. GXP Fusion represents a scalable, dynamic, and resilient enhancement to traditional intelligence workflows by serving up relevant data from disparate sources into a real-time, configurable dashboard. Providing operators with access to the data they need, when they need it, GXP Fusion leverages the power of the GXP product ecosystem and third-party ML/AI technologies to provide a unique solution to a complex problem.

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Supporting development of the most advanced geospatial intelligence, BAE Systems Geospatial eXploitation Products™ (GXP™) software enables rapid discovery, exploitation, and dissemination of mission-critical geospatial data. From key military, security, and incident response operations, to a variety of commercial development and research initiatives, GXP provides a comprehensive suite of solutions to inform effective decision-making and ensure a safer world.