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Creating a Seamless Information Grid

Executive Summary

The coherent integration of data from multiple sources into a single view across agencies will shape the future of the Security and Intelligence Community by utilizing data fusion to achieve actionable intelligence.

Getting there is no easy task. In today's security landscape, Government Agencies have more data to analyze, with greater complexity, coming from more sources, than ever before. In addition, there are more users – with differing levels of clearance – needing answers from the data in order to make mission-critical decisions.

This brief examines the challenges faced by designers of advanced data fusion systems for Government Security and Intelligence Agencies. It contains case studies describing how some of these challenges have been handled and then briefly outlines the pertinent features of Objectivity/DB, a possible database system management solution.

The Challenge of the Network-Centric Enterprise

It's one thing to collect and file massive amounts of information; it's an entirely different matter to interpret its real meaning or to find pertinent and timely information hidden within it. Data fusion systems must be about more than "What Is." They must also be about "What Is Not" and "What Might Be," with models that appropriately handle uncertainty and unanticipated threats.

Take Figure 1, "A Visualization of a Terrorist Network," as an example. There is a wealth of data, including information regarding the activities and details of a terrorist network, which is gathered and stored continuously. Making sense of this information and determining what is important and what is not important can be time consuming if you don't know exactly what to look for. Analysts need triggers to alert them when data anomalies occur or to help predict an unknown future event.

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One part of the problem is that legacy technology can only store and query relatively simple information. These databases were not built to manipulate the many kinds of complex data that are being collected and processed in today's systems. Increasing demands, particularly in the areas of Homeland Security and National Defense, will place even greater strains on the legacy systems.

Another major issue is that most data mining tools were not built to deal with complex data. They are not good at following and exploring relationships between data items, particularly where there are many types of relationships. In many cases, the relationships between items only become clear as the users explore existing data to solve a problem. Users must be able to define and record newly discovered types of relationships. Storing these relationships and building increasing numbers of indices over frequently used data puts an added burden on legacy systems.

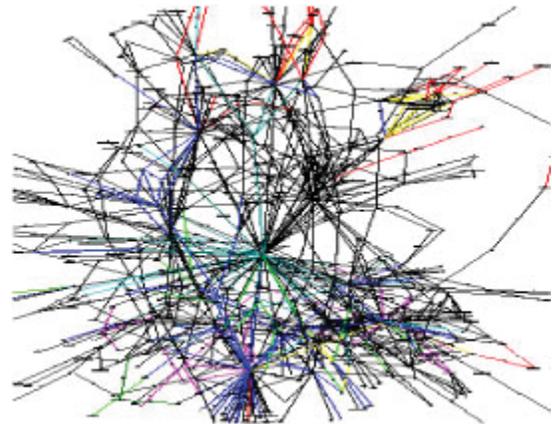


Fig 1 A Visualization of a Terrorist Network

The increased power, capabilities, and adoption rates of computers and communications systems are generating exponentially increasing amounts of data. Any attempt to centralize all of this data in a single database repository is doomed to failure. Maintaining central server databases becomes very difficult as the number of data types, relationships between data, and data instances grows.

Additionally, there is a growing need to share information across agencies. Users need a single logical view of all data specific to the situation they are dealing with whether the data was collected and stored by an ally government, the CIA or local law enforcement. Data access must be governed by the security policies of the various countries and agencies that are sharing the information, including categorization of information by security clearance level. It must also be possible for organizations to add new types of data and relationships to existing databases, even when the ownership of that data may reside elsewhere.

Case Study: THREADS:

Counter-terrorism analysts needed an application to compile and analyze HUMINT – intelligence that comes from human sources – with an end goal of generating actionable information. THREADS was the proposed application, and its developers set out to find the best database management solutions for the complex task.

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Having already used Objectivity/DB to create ASA, a similar intelligence tool, the developers knew from first hand experience that Objectivity/DB allowed them faster development and proven scalability, among other advantages. Nonetheless, they created a performance study, pitting Objectivity/DB against a leading relational database management system (RDBMS).

The competing databases were tested for speed and accuracy in data insertion, messaging, EEsI, and deep queries. In every test, Objectivity/DB matched or beat the RDBMS. In deep queries, Objectivity/DB was 25 times faster. Objectivity/DB was the clear choice for the THREADS project.

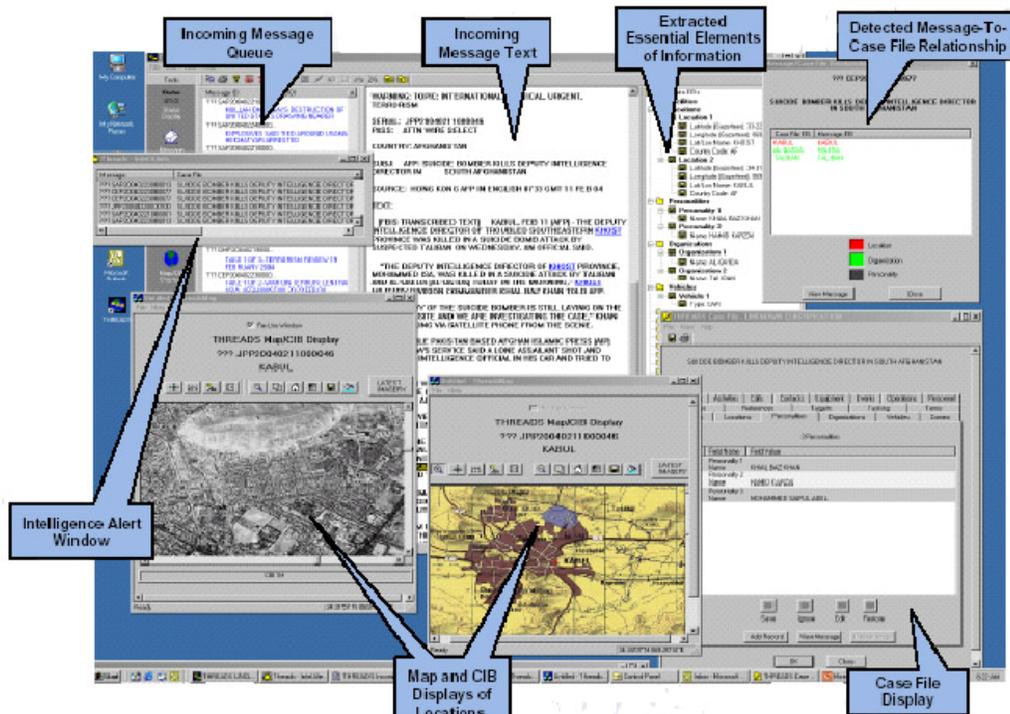


Figure 2. THREADS desktop display.

OBJECTIVITY/DB

Objectivity/DB is already at work in applications that are central to Government Agencies involved in Security and Intelligence initiatives, including:

- security analysis
- cryptanalysis
- social network analysis
- knowledge and case management
- terrorist mapping networks
- geospatial data fusion
- ACINT, COMINT, ELINT, HUMINT and SIGINT analysis

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The Objectivity/DB platform is the leading high performance object database platform for sophisticated applications, with unrivaled support for heterogeneous computing environments. Objectivity/DB boosts developer productivity, shortens development time, and provides the ideal platform for mission-critical applications requiring continuous performance and adaptability to future technologies. Objectivity/DB:

- enables applications to analyze and correlate streaming event data and its complicated inter-relationships with known attributes
- provides a clear real-time picture of known events, anomalies, and outcomes
- analyzes in real time the complicated inter-relationships between data
- provides real-time access to the complicated inter-relationships found between data that is housed in disparate databases within a single logical view

Productivity and Ease-Of-Use

A rich set of administration tools provides complete control over the database. These include: dynamically sized objects, composite objects, and objects related through dynamic bi-directional links. A sophisticated object clustering mechanism allows logically related objects to be physically grouped to minimize I/O and locking overhead.

The Objectivity/DB platform, which stores and manages complex information as objects, enables high performance process control applications to be built with virtually unlimited scalability, reliability, availability, and flexibility.

Performance

Objectivity/DB is a highly reliable data management repository that can support extremely demanding, high-precision intelligence applications involving complex, highly interrelated data. Objectivity's object-oriented database platform employs new techniques to deal with modern architectures and language paradigms. Depending on the complexity of the data being handled, Objectivity/DB can outperform traditional relational databases (RDBMS) by 10 to 1,000 times. The Objectivity/DB platform has demonstrated an ingest rate exceeding 1 Terabyte per hour in a 32-processor configuration.

Scalability

The ability to scale while managing complex data relationships enables Objectivity/DB to solve problems that are difficult and expensive to resolve using traditional database technology. Objectivity/DB enabled the Department of Energy to build the world's largest database, exceeding 1,000 Terabytes.

Objectivity/DB is the first commercially available database to scale to the Exabyte level.

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Flexibility

Objectivity/DB runs on a wide variety of platforms including Linux, UNIX, Windows, and LynxOS and supports C++, C#.NET, Java, Python, Smalltalk, SQL/ODBC, and XML environments. Objectivity provides productivity tools, training and consulting to speed process control application development. Objectivity/DB federated databases can be in a single platform or distributed seamlessly across a network. This architecture supports a many different application designs, including client/server and mixed-tier. The elements of this heterogeneous environment interoperate so that all users have a single logical view of the distributed data. Because of its 1.5MB footprint, Objectivity/DB can be deployed anywhere from a control center all the way to individual control components.

Reliability

Objectivity/DB ensures the availability of data and business-critical applications despite network or system failures. Objectivity/DB's distributed architecture means data, distributed across any number of file server hosts, can be transparently replicated at different sites for fault tolerance or to improve performance locally. For continuous (99.999%) availability, Objectivity/DB also includes a High Availability Option which offers developers superior fault tolerance that ensures data and business-critical application availability despite network or system failures. It provides fault isolation and improved transaction performance by replicating system services. Additionally, Objectivity/DB multiple-site user data replication for continuous availability and improved performance provides a combination of data integrity and availability not offered by other replication solutions, making it the clear choice for distributed, scalable, mission-critical applications.

Objectivity/DB is fully scalable and a proven performer. Clients and partners include the FBI and NASA, defense contractors such as Northrop Grumman and Lockheed Martin, and researchers like the Los Alamos National Laboratory and the U.S. Department of Energy.