Accelerating Complex Event Processing with Memory-Centric DataBase (MCDB)

A FedCentric Technologies White Paper

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Executive Summary

Events happen in real-time; orders are taken, calls are placed, network resources are used, supplies move through the supply chain interactively. The quantity and rate at which data is created, processed and analyzed continues to rise dramatically, along with the increasing complexity of those events. Streams represent events that if analyzed and processed, could benefit your business.

There are applications that require quick, accurate and actionable event processing, including Fraud Detection, Revenue Protection, Enterprise Biometrics, Social Network Analysis, Global Epidemic Warning Systems, Bio-Terrorism Detection, Traffic Analysis, Network Monitoring and Intrusion Detection. These areas involve enormous quantities of data arriving at very high data rates. Your ability to analyze, process and react to these events may lead to fewer losses, increased profits, greater safety and higher customer satisfaction.

The question arises: How can my organization process complex events quickly? Traditional disk-oriented databases and data warehouse technologies may not be able to maintain the pace required to process complex events. Memory-Centric Database (MCDB) Acceleration provides technology to realize this goal. MCDB can perform hundreds or thousands of complex event tests in real-time, and can accelerate the speed and accuracy of complex event processing.

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Introduction and Definitions

We live in a world of constantly occurring events, some simple and independent, some complex and interrelated. For the purposes of this paper, we will define an **Event** as "Something that happens in time and space." Examples of simple events include:

- a financial transaction (buy or sell),
- an airplane landing or takeoff,
- a sensor output,
- a key stroke or a mouse click on a Web page,
- an occurrence such as an earthquake,
- an attempt to log into a secured Web site.

A **Complex event** is an event that abstracts or aggregates simple (or member) events. Examples of complex events include:

- the 1929 stock market crash,
- the 2004 Indonesian Tsunami,
- a traffic jam during rush hour,
- a completed stock purchase,
- A successful on-line shopping cart checkout,
- A terrorist attack on a hotel in Bali, Indonesia.

Often, simple or complex events present themselves in a linearly ordered sequence of events, an **Event Stream**. Usually, streams are ordered by time, and may be bounded by a certain time interval or other criteria (content, space, source), or be open ended and unbounded. A stream may contain different types of events.

Reference: "Event Processing Glossary", http://complexevents.com/?p=195, accessed Jan 19, 2008

As the quantity and complexity of events rises, so do processing requirements. Event Streams involving credit card fraud, network intrusion, or global epidemic detection, demand timely actionable results. The longer these kinds of financial, resource, or health risks remain undetected, the more expensive, embarrassing or threatening the consequences. How does one accelerate processing the vast quantity and complexity of events? Traditional disk-based databases and data

warehouses may not be able to keep up with throughput and latency requirements. MCDB Acceleration offers the ability to realize real-time complex event processing.

Memory Centric DataBase (MCDB) Acceleration uses commodity hardware components and random-access memory (RAM) to deliver breakthrough performance, typically an order of magnitude or greater, using less power, space and cooling than traditional disk-centric approaches. MCDB uses disk for capacity not performance, thereby enabling tremendous results.

FedCentric Technologies has experienced 10 to 1,000 times speedup in real application performance. MCDB allows businesses to process vast quantities of data in near real time. MCDB provides the perfect high-performance engine for Complex Event Processing and Event Stream Processing applications.

Real-time Complex Event Processing Use Cases

What kinds of Complex Event Processing applications can benefit from FedCentric's MCDB Acceleration?   We provide a few candidate examples below. This list is representative and should not be viewed as an exhaustive or complete description of the types of applications that can benefit from MCDB use.

Intelligence & Defense

The paramount goal of Intelligence is to determine a potential adversary's intentions ahead of time. A stream of individual events might involve normal activity or the precursor to some hostile act. Modern intelligence problems involve constant streams of events from many different sources, including open sources like cable news services and classified collection systems that take in vast quantities of data. Processing and analyzing these events automatically and in real-time enables analysts to spend less time waiting for queries and more time looking for the patterns. Success is defined by the Government's ability to deliver actionable results against a ruthless and determined foe.

Defense operations are increasingly information-oriented. Deriving a common tactical picture from various sensor inputs in a complex battlefield is an ongoing challenge.

Financial Services Fraud Detection

Credit card fraud is big business, costing companies billions of dollars in lost revenue. Merchants in high-risk industries, like unattended automated fuel pumps or Internet sales, anticipate a certain amount of credit card fraud, and set prices accordingly. These higher costs are then passed onto the customer.

A man tries to buy a new camera with a credit card. Should this simple event, a credit card transaction, be authorized? Does the timing, location, amount, or buying history suggest this purchase is consistent with this consumer's usual buying pattern? Or does this purchase suggest the buyer is trying to use someone else's credit card in a fraudulent way?

The ability to answer more of these kinds of questions in real-time has the potential to reduce the cost and incidence of credit card fraud. MCDB acceleration can perform the hundreds or thousands of pattern matching and analysis tests in real time on transaction data, giving better and faster answers to these types of question.

Fraud Detection & Revenue Protection

Commercial and Government service providers need to know who is using their services and that customers are paying for the services they use. Fraudulent use of credit cards, Medicare, mail delivery services, and telecommunications result in billions of dollars of lost revenue each year. Reducing the risk and cost associated with fraud requires high speed detection and processing.

FedCentric's Memory-Centric Database (MCDB) solution speeds up the processing so that threats can be identified, usage patterns detected and unauthorized service usage prevented in short order.

Enterprise Biometrics

Biometrics involves methods for uniquely recognizing humans based upon one or more intrinsic physical or behavioral traits. Biometrics typically involves scanning a person's face, fingerprint, voice or retina, and processing hundreds or thousands of complex checks to ascertain the

identity of the person requesting access. As companies embrace and adopt biometric-based access controls, the scale and speed required to perform the requisite pattern matching increases. Authorization delays impact employee productivity and may cause customer dissatisfaction.

FedCentric's Memory-Centric Database (MCDB) solution speeds up the processing of enterprise biometrics such that usage patterns can be monitored in real-time and response times to allow or deny access reduced to the absolute minimum, regardless of the number and types of accesses made.

Social Network Analysis

Determination of the interactions that take place in social networks give companies a competitive advantage in understanding how customer buying decisions are made and how to market and sell to various social groups. Government agencies charged with protecting our nation's security can gain a better understanding of intent by analyzing the social interactions that take place between various hostile entities. Being able to discern shifts or changes in social network patterns in real time requires a high throughput, low latency engine that can capture and analyze the increasing number of social interactions in real-time.

FedCentric's Memory-Centric Database (MCDB) solution speeds up the processing of social network analysis such that usage patterns can be monitored in real-time and response times to act on significant interactions or changes in usage patterns can be reduced.

Global Epidemic and Bio-terrorism Detection

Today's global economy and air transportation system can transmit an outbreak of disease from one part of the world to destinations across the planet in a matter of hours. Whether the outbreak is a natural occurrence or a carefully orchestrated act of terrorism, early detection and warning can be critical to a containment and treatment strategy.

FedCentric's Memory-Centric Database (MCDB) solution speeds up the processing of disease outbreaks such that transmission patterns can be monitored in real-time and response times to act on significant changes in transmission patterns can be reduced.

Real-time Traffic Analysis

Next generation cars and highways may be fitted with sensors that monitor location and speed of traffic. When weather conditions or accidents impact the flow of traffic, it is paramount to be able to monitor and analyze the congestion and deploy the right measures to restore regular traffic volumes.

FedCentric's Memory-Centric Database (MCDB) solution speeds up the processing of traffic information such that proper services can respond to and correct restrictions in traffic flow in the shortest possible timeframes.

Network Monitoring and Intrusion Detection

Company intranets, extranets, virtual private networks and the Internet have enabled huge productivity gains by providing timely and accurate information. These same technologies have become the focal point of hackers and cyber criminals looking to exploit these same networks for illicit activities. It becomes very difficult to sift through the volumes of monitored network traffic because of the amount and rate of data generated by switches, routers and firewalls.

FedCentric's Memory-Centric Database (MCDB) solution speeds up network monitoring and intrusion detection such that attempted or successful access patterns that indicate an unauthorized access can be detected in real-time, reducing the window of time and consequent damage that an intruder could cause.

Summary & Conclusion

Memory-Centric Database (MCDB) Acceleration enables the processing of complex events with orders of magnitude performance gains over traditional disk-based systems. MCDB could accelerate the broad array of complex event processing applications. Any system that simply needs to process complex events faster can benefit from MCDB Acceleration.

The value of MCDB to Government and commercial customers includes reduced costs, increased throughput, early warning and detection of unauthorized activity, and increased productivity and security.

Please contact FedCentric Technologies to further discuss how MCDB might accelerate your mission and business effectiveness. **"What would you do with an order of magnitude increase in database performance?"**

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About FedCentric Technologies, LLC

FedCentric is a recognized thought leader and practitioner in the area of memory-centric database acceleration. We combine the unique capabilities of SGI's open standards-based Altix hardware with the simplicity and raw speed of Oracle TimesTen In-Memory Database (IMDB) to help customers realize the benefits of Memory-Centric Database Acceleration.   FedCentric is an authorized reseller of SGI Altix computers and Oracle TimesTen IMDB software.   MCDB Professional services are provided by Integrated Computer Concepts Incorporated, a FedCentric partner.

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