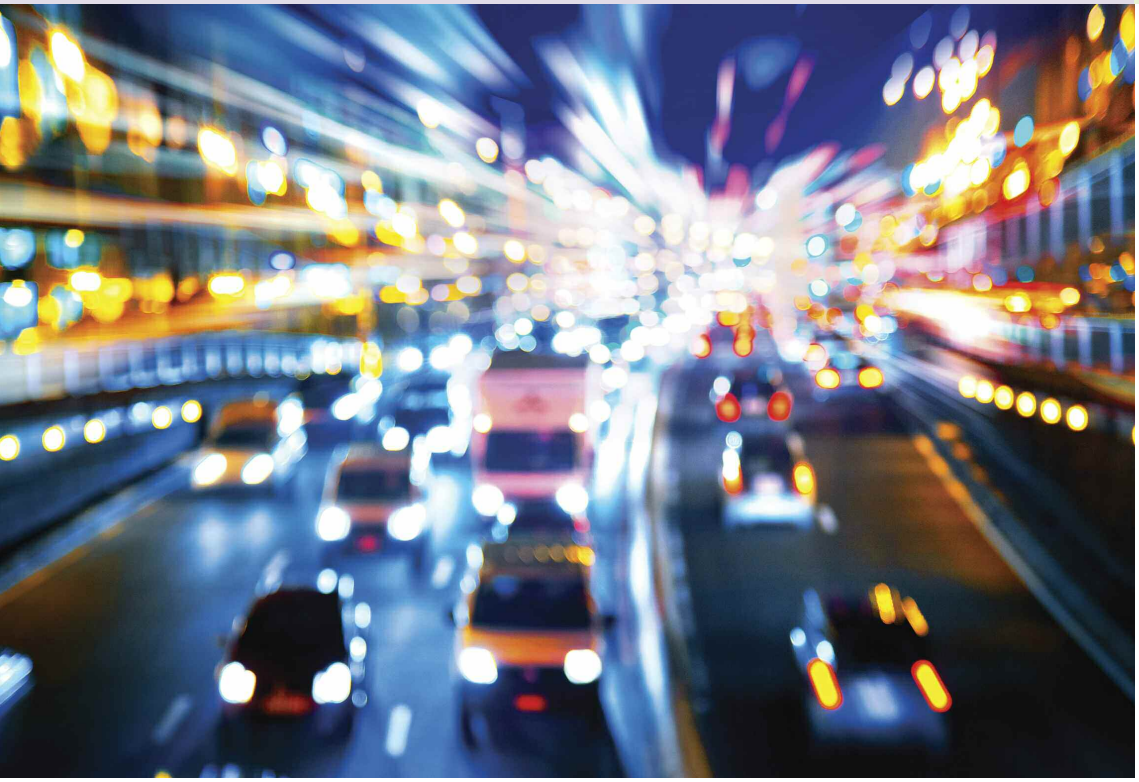

Trading and risk management: Benefits of multi-core, time-critical, high-volume, real-time data analysis

Industry
Financial Services

Business Challenge
Ultra high-speed processing and analysis of virtually unlimited quantities of real-time and historical financial market data to meet business, regulatory and risk management requirements

Technology Solution
kdb+tick from Kx Systems

Enterprise Hardware Platform
Scalable on platforms based on the Intel® Xeon® Processor E5 & E7 families

SOLUTION ARCHITECTS

THE BUSINESS CHALLENGE – DATA/RISK MANAGEMENT AND REGULATION

Today's financial institutions need to be able to collect, analyze and store vast quantities of data. They must also have a clear view of their positions in near real-time to help maximize profits from all forms of trading, including algorithmic and non-program trading, for effective risk management and to satisfy increasingly stringent regulatory requirements.

The practice of discarding streaming data when memory capacity is reached is no longer acceptable for firms. Being able to store and analyze streaming data at near real-time speeds and save it to the in-memory intra-day database is essential for meeting regulatory requirements and helps to establish and maintain a significant competitive advantage. This enables financial institutions to perform sophisticated mining of data and to develop competitive trading strategies which can be rapidly brought into production. There is also a requirement to compare real-time data with historical data which is stored on SSDs or disk, tiering storage to meet performance requirements. Compute-intensive applications, for example evaluating risk management decisions in real-time, will quickly overburden traditional databases. With market regulations, such as RegNMS, Dodd Frank, Basel III and MiFID, financial institutions are being required to store and access many years of raw historical data.

Pre-trade risk analysis across all asset classes is now an essential constituent of the overall risk management strategy. This necessitates analysis of very large quantities of real-time and historical market data from numerous exchanges and other sources worldwide. Cross-asset analysis is vital in assessing risk from a holistic perspective, making asset-specific risk measurement too simplistic for the complexity of the markets.

As more and more transactions are conducted electronically the volumes of data are increasing and frequently amount to billions of records per day. Institutions must be able to handle high ongoing data volumes, high-volatility market events and trillions of historical records while satisfying increasingly tight compliance and regulatory requirements.

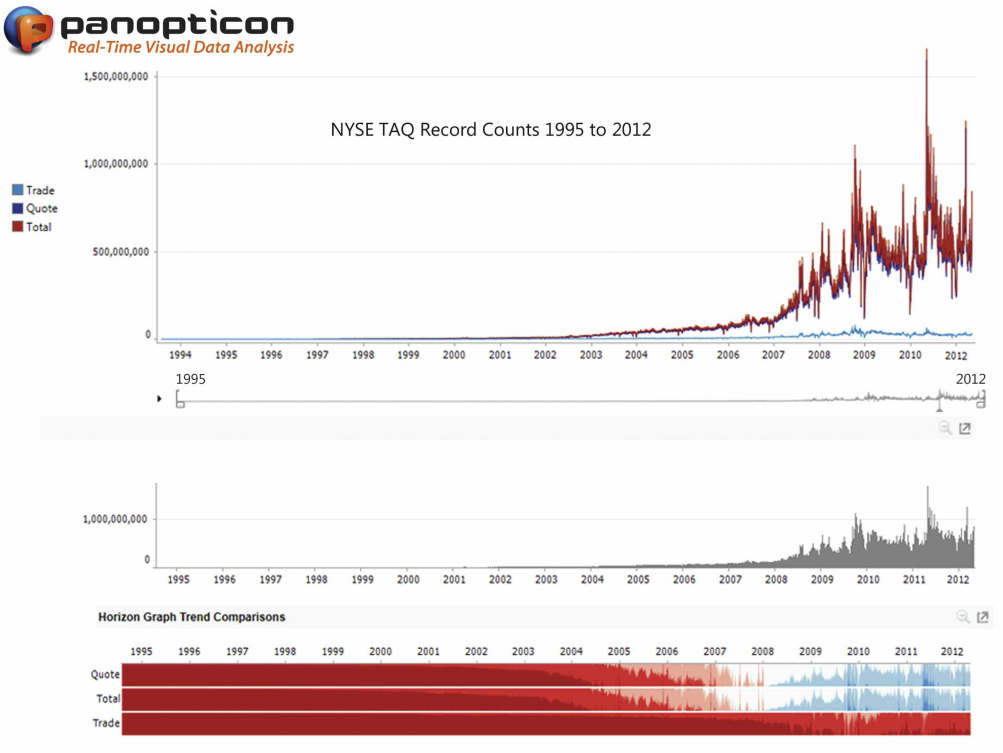

Figure 1. New York Stock Exchange Trade and Quote record counts. Source: NYSE

An intelligent and robust technical foundation is the vital key to meeting these business challenges. SSDs and vast quantities of memory are now far more cost-effective and, coupled with the latest generation of Intel processors, provide the future-proofed power for meeting the demands and increasing pressures institutions face in analyzing data.

Most financial institutions have already made substantial investment in technology. A critical issue is extending the value of legacy applications and data without enormous investment in integration time and complexity. The kdb+tick solution running on platforms based on the Intel Xeon processor E5 & E7 families provides a seamless path to ultra-fast, multi-core computing and offers trading departments the horsepower to meet future challenges in data analysis efficiently, even as they continue to use legacy infrastructures.

MEETING NEW MARKET DEMANDS

The kdb+tick solution from Kx Systems is an ultra high-speed database designed to capture and analyze virtually unlimited quantities of streaming market ticks for immediate analysis. Used globally by trading groups at leading banks, brokers, hedge funds, asset managers, exchanges and other financial institutions, kdb+tick captures streaming data from numerous sources and analyzes it at real-time speeds for program trading, pre-trade risk and other real-time operations. The solution also stores the data so it can be used for back-testing trading strategies and performing large-scale trend analysis. kdb+tick is ideal for time-critical applications such as proprietary trading, real-time risk management and regulatory compliance. The speed of processing which is now available makes it possible to do visual analysis in near real-time.

The kdb+tick solution, combined with the Intel Xeon processor E5 & E7 family-based platforms, delivers the high message rates and fast response times needed to analyze massive flows of streaming data. Based on the advanced Intel® Core™ microarchitecture, the latest Intel 32/22nm logic technology, which uses Intel's high-k metal gate transistors to increase speed and decrease energy consumption, Intel Xeon processors bring higher performance along with reduced power consumption and heat production for the ultimate in powerful, dense, energy-efficient servers.

These top-of-the-line processors deliver performance which is ideal for the most demanding kdb+tick workloads; they improve scalability, increase memory and I/O capacity, dramatically reducing latency and increasing throughput. Advanced reliability and security features maintain data integrity, accelerate analysis and maximize the availability of mission-critical applications. The introduction of the E5 platform and kdb+ v3, which supports AVX instructions, enhance floating point performance by up to 140%.

For further information on the E5 see:
http://www.intel.com/performance/server/xeon/summary.htm
For further information on the E7 see:
http://www.intel.com/content/www/us/en/processors/xeon/xeon-processor-e7-family.html

THE SOLUTION OVERVIEW

Designed from the start to take advantage of multithreading, kdb+tick is an intelligent and elegant solution which captures, analyzes and manages billions of streaming ticks per day, as well as hundreds of terabytes of historical tick data, producing analysis results in real-time. It enables users to insert, update and query data coming directly from any data stream, whether exchange, in-house or vendor sourced, and has the capacity to handle unusual peaks in trading volumes which might be caused, for example, by unexpected major events resulting in significant market movement and volatility. The volume of trades and quotes being processed by institutions is continuing to see considerable growth, and shows no signs of slowing; together with data peaks caused by increased volatility this is putting an additional strain on systems.

The kdb+tick solution is able to capture millions of records per second, and billions of records per day, enabling trading groups to implement sophisticated trading strategies in real-time, no matter how much the volumes of data increase or fluctuate.In handling such a large number of inserts per second, kdb+tick also delivers the headroom to go far beyond simply capturing and updating market data. For example, it can simultaneously support many thousands of real-time custom queries and proprietary analyses on data in-memory, dynamically update database indices to speed query execution and log data to the file system.

Once saved to disk massive quantities of kdb+tick data can be queried at speeds of hundreds of millions of records per second per processor. Saving streaming data allows firms to test their strategies and mine market data history for the trading intelligence which creates a competitive advantage.

TECHNOLOGY

The kdb+tick solution features the following technologies:

- Application architecture. The kdb+tick solution is a tick data capture application, layered on the Kx Systems kdb+ database. The database includes a high-level programming language, q, designed to work with time-series data. It also provides interoperability with other databases and open interfaces to C, C++, Java* and .Net* applications.
- Hardware and software architecture. The kdb+tick solution runs on platforms based on the latest Intel Xeon processor family (64-bit, multi-core) using Linux*, Mac OS X*, Solaris* and Microsoft Windows* operating systems.
- Servers based on the multi-core Intel Xeon processor E5 & E7 family-based platforms, with their high speed and large cache, are well suited to handle the transaction volumes and the sophisticated analysis requirements which applications such as kdb+tick facilitate. Intel Xeon processors built on Intel Core microarchitecture also feature Intel® Intelligent Power Capability to manage the runtime power consumption of all the processor's execution cores, resulting in excellent energy optimization. The Intel Quick Path Interconnect optimized multi-core caches significantly reduce data latency, improving performance and efficiency.
- Storage arrays based on Intel® Solid State Drives (Intel® SSDs) are well suited to provide the lower latencies and higher I/O that lead to better performance with kdb+tick. The use of Intel SSDs also reduces the storage footprint and power consumption since very high performance can be achieved with fewer drives.

BENEFITS OF THE SOLUTION

The kdb+tick solution is designed for financial services firms worldwide. Engineered to meet the needs of trading directors, who depend on capturing all of the data all of the time, kdb+tick has been used for many years by global and central banks, exchanges, regulators, asset managers, insurance companies, hedge funds and pension funds. It performs sophisticated analysis on large volumes of in-memory and historical data, offering institutions advanced risk management and key competitive advantages, including unparalleled speed of analysis and access to data, flexibility and easy integration.

CUSTOMERS

Please see http://kx.com/end-user-customers.php for a list of some of the Kx Systems customers using the kdb+tick solution.

SOLUTION FUNCTIONALITY

The benefits provided by the kdb+tick solution in conjunction with the Intel Xeon processor E5 & E7 family-based platforms include:

- Ease of installation and programming. The kdb+tick solution can deliver production applications within 24 hours of installation and provides a fast return on investment (ROI).
- Integrated streaming, real-time and historical data. The kdb+tick solution supports queries against streaming, real-time or historical data, or a combination of any of these.
- Fast data capture and analysis even as data volumes continue to rise.
- The kdb+tick solution provides a scalable path for growth and a rapid ROI.
- Multithreading capabilities are embedded in the kdb+tick solution so developers can take advantage of parallel processing without changing their code.
- Scalability – the kdb+tick solution provides virtually unlimited room to grow with short- and long-term profitability requirements, helping to lower total cost of ownership (TCO).
- Compatibility with legacy technologies.
- Cloud computing – this will provide significant opportunities for customers; the combined Intel/Kx solution provides an efficient method of utilizing the power of the cloud.
- Optimized energy efficiency – the kdb+tick solution is performance-tuned for the Intel Xeon processor E7 family-based platforms, which automatically and intelligently adjusts server performance according to application needs. Users get maximum performance when needed and gain significant energy savings at other times.
- The Intel Xeon processor E5 family-based platforms, when combined with kdb+ v3, provides enhanced floating point performance through the implementation of AVX instructions and the increase in floating point registers from 128bit to 256bit. Kx Systems testing has shown a performance increase of up to 140% for these types of computational requirements.
- Storage array based on Intel® SSDs - the Intel SSD DC S3700 delivers data at exceptionally high speeds, with consistently low latencies and tight IOPS distribution. The Intel Solid-State Drive DC S3700 Series provides superior performance with 4KB random read speeds of up to 75,000 IOPS and 4KB random write performance of up to 36,000 IOPS; the DC S3700 Series ensures quick and consistent command response times. This outstanding performance is delivered with low active power consumption (less than or equal to 6 watts), helping to reduce overall energy costs and the total storage footprint.

FUNCTIONAL BUSINESS CONCEPT

The kdb+tick solution combines streaming, in-memory and on-disk data into a single database for the purposes of analysis. Users can set up as many data services as are relevant to their trading department functions and provide those data services to an unlimited number of application clients. Streaming real-time data from market feeds is saved in-memory to the real-time database, and is logged and saved to history on disk. Users can query the real-time database, the historical database or the combined database as needed, to support a variety of trading, risk management and compliance/regulatory applications.

SOFTWARE ARCHITECTURE

The kdb+tick solution is a tick data capture application layered on the kdb+ database. The database includes a high-level programming language designed to work with time-series data. In addition, it provides interoperability with other databases and open interfaces to C, C++, Java and .Net applications.

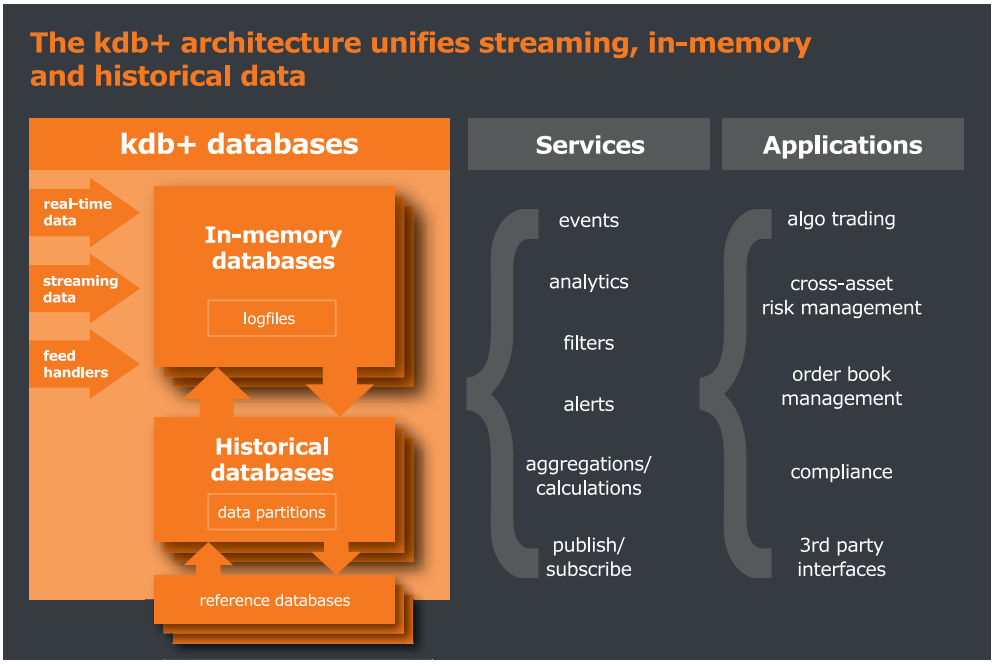

Figure 2. The kdb+tick solution provides immediate access to data as it comes in and can run complex queries on real-time, streaming and historical data.

SYSTEM ARCHITECTURE

- Future scalability. Clusters, grids and proprietary clouds are increasingly seen as solutions to large-scale computing challenges, such as those which the kdb+tick solution addresses. Servers based on multi-core Intel Xeon processors are the clear choice for multiprocessor systems. Their ability to support large quantities of memory makes them ideal for those computing environments. In addition, their included Intel® Virtualization Technology and unsurpassed virtualization headroom mean greater performance and higher solution ROI.
- Future-proofed. Unlike legacy systems, the kdb+tick solution was designed from the outset for multi-core architectures, offering significant speed advantages. The kdb+tick solution running on multi-core Intel Xeon processor-based servers provides a scalable path for growth and a fast ROI. As high performance multi-core servers increase in socket and core count, kdb+ is well situated to take advantage of the additional processing power.

BENCHMARK RESULTS

STAC®, the vendor-neutral facilitator of the STAC Benchmark Council, released an audited set of STAC-M3™ Benchmarks of Kx Systems kdb+ v2.8 on the IBM System x3850 X5 server and ION® STORION SR-71 Storage Appliance with Intel® SSD 320 Series. STAC-M3 was developed by leading trading firms and vendors to test solutions which manage large tick-by-tick time-series of financial data (i.e. tick databases). STAC-M3 tests the ability of a system to handle various I/O- and compute-intensive workloads typical in areas such as equity research, post-trade reporting and end-of-day processing (e.g. NBBO). This solution stack sets a new bar for performance by breaking several records and efficiently handling compute-intensive tasks and multi-user scaling. For the full STAC Report™ see http://stacresearch.com/node/11939

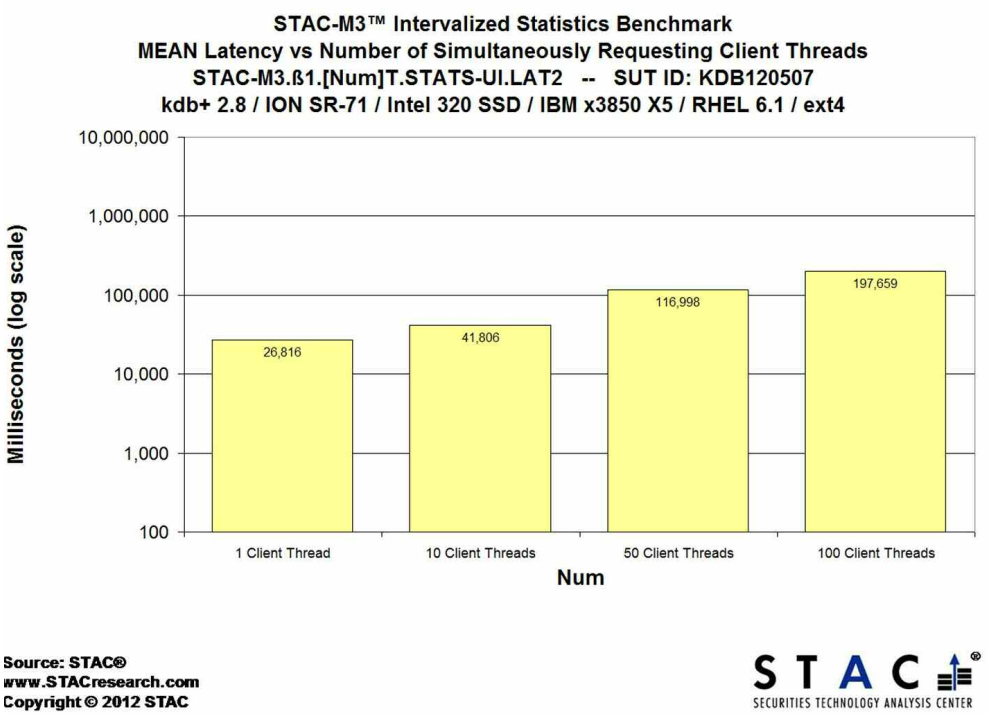

Figure 3. This is the audited STAC-M3™ benchmark of kdb+ software hosted on an IBM x3850 X5 Server with Intel Xeon E7-4870 CPUs. It provides a more explicit look at multi-user scaling by plotting the latency for the intervalized statistics benchmark against the number of simultaneously requesting client threads (n).

SUMMARY

To achieve and maintain a competitive advantage and meet compliance and regulatory requirements financial institutions need to be able to capture, analyze, store and manage huge volumes of both historical and real-time data in order to make time-critical investment and risk management decisions. The kdb+tick solution from Kx Systems, running on Intel Xeon processor E5 & E7 family-based platforms, is an ultra high-speed, scalable and open database solution tailored to meet these demands. The solution relies on the processing horsepower and fast memory access of the multi-core Intel Xeon processors to rapidly process massive quantities of data in real-time, providing excellent decision support. The solution can be easily integrated with other applications, as well as with legacy systems and applications, extending ROI and lowering TCO.

LEARN MORE ABOUT THE BENEFITS OF THIS INNOVATIVE SOLUTION

For general information about the products described in this solution blueprint, visit:
Kx Systems: http://kx.com/

Intel Premier IT Professionals: http://www.intel.com/products/server/processor/

STAC-M3 results: http://www.stacresearch.com/node/11939

If you have specific questions about implementing this solution within your organization, contact your Intel representative or contact Kx Systems at: info@kx.com or phone: +1 212 792 4230

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