**Kx for Surveillance enables regulators, exchanges and industry practitioners to monitor trading integrity and efficiency.**

Regulators and exchanges scrutinize member trading activity for signs of manipulation, collusion or insider trading that may undermine market integrity. Brokers do likewise, searching for similar activity that may undermine their very existence. A common requirement of both is to capture, store and process vast amounts of data, both structured and unstructured, in nanosecond timeframes to detect such malpractice and a system to do it requires the best in technology, design and domain expertise. Kx provides all three in its market proven solution, Kx for Surveillance.

**Technology:** Powered by *Kx technology*, the high-performance database that is used by the largest investment banks and hedge funds for high frequency, low-latency algorithmic trading.

**Design:** Built on Stream for Kx, a proven CEP solution providing capabilities for real-time data capture, storage and analysis. It also provides users with a framework to develop and deploy customized analytics that quickly perform complex calculations on enormous volumes of data.

**Expertise:** Kx solutions have been developed by experts in technology to achieve the low-latency, high-performance and high-availability profile that a Surveillance solution requires. Additionally, on the business side, it incorporates the design, insight and practical experience of people who know the Surveillance market, speak its language and understand its requirements—people who have built trading solutions, worked on exchanges and know market practices.

Kx for Surveillance enables institutions to instantly detect known violations like layering, spoofing or marking the close. It enables them to calibrate their parameters in real time to improve their quality and accuracy. And for as yet unknown or evolving techniques, its historical database and replay engine enables them to investigate and search for patterns and relationships in post-trade data.

Kx provide an accompanying range of services and support for all its products. We provide a pool of talented and experienced developers with deep domain knowledge to assist clients in developing customised solutions that distinguish them in the market place. We provide services for defining, designing, testing and rolling out new functionality with supporting project management services to ensure control, quality and on-budget delivery. Kx also offers both public and private training services customized to client needs ranging from new system design and implementation guidelines to code optimization and architectural reviews.

Kx has operational bases in Europe, North America, Asia and Australia to service its global client base both locally and on a near-shore basis.
**Solution Overview**

Kx for Surveillance is a proven solution used by clients such as ASIC (Australian Securities and Investment Commission) and the Singapore stock Exchange to provide real-time visibility into trading profiles and alerting on unauthorized or suspect trading activity. It is built upon Stream for Kx – a highly powerful CEP engine based on Kx designed for capturing, storing and analyzing data at the high volumes and velocity of today’s trading environments.

### Solution Architecture

- **Multi Asset & Multi Market** - High-performance data capture (rates, trades, orders, news) across multiple asset classes and markets
- **Backtesting & Calibration** – allows surveillance analysts to test new alert algorithms against historical data and to recalibrate alerts to minimize false positives
- **Market Visualization** – highly flexible dashboards for surveillance analysts to monitor real-time trading activity and perform post-trade analytics and reporting
- **Alerts** – flexible CEP engine and alerts definition for instant deployment and detection of trading patterns indicating market abuse, erroneous trading or malfunctioning algorithms
- **Market Replay** – to reconstruct market conditions and step forward and backward through order book activity for cross-market and single-market analysis

- **Feedhandlers** ingest the tick data received directly from the trading venues and market data sources
- The **Tickerplant** receives, logs and then publishes all real-time data downstream
- The **RDB** (real-time database) captures all intraday data, writes to disk at end of day
- The **HDB** (historical database) processes read historic data from disk and provide to other processes

- **Time-stamping** – nanosecond accuracy for precision tracking of market data and transactions
- **Open architecture** – allows for easy integration of other data sources and to external feeds systems
- **Structured and unstructured data** – interfaces to multiple data architectures to ingest, index and categorize all data types (transactions, rates, news, email, tweets..)

### Benefits of Kx for Surveillance

- **Speed & flexibility** enabling users to easily add new alerts, parameterization to instantly amend existing alerts, real-time processing, market replay and incorporation of historical data for post-trade analysis.
Why Kx for Surveillance

Kx for Surveillance has been developed by experts in technology to achieve the low-latency, high-performance and high-availability profile that a Surveillance solution requires. Additionally, on the business side, it incorporates the design, insight and practical experience of people who know the Surveillance market, speak its language and understand its requirements – people who have built trading solutions, worked on exchanges and know market practices. This combination of technology knowledge with domain expertise distinguishes Kx for Surveillance as a market-leading solution and reduces adoption risk.

<table>
<thead>
<tr>
<th>Key Advantage</th>
<th>Details</th>
</tr>
</thead>
</table>
| Architecture           | - Built on proven algorithmic trading infrastructure.  
- Kx Technology-based solution providing high scalability and performance to grow with increases in venues, alerts, users.  
- Interfaces to multiple data architectures covering structured and unstructured data. |
| Performance            | - Highest performing time-series database available and has been used for decades for tick capture.  
- The tickerplant is a very fast, lean optimized process that has been benchmarked on a simple architecture machine to ingest up to 500,000 messages per second.  
- Overall the system has been proven to capture over a billion order book events per day. |
| Exchange Database      | - Complete Data Warehouse-centric view with full depth real-time tick data and history going back decades.                                                                                             |
| Flexibility            | - Modify alert parameters in real time (instant tuning).  
- Backtest alerts and run tests in sandbox environments using production data enabling accurate calibration of rules and parameters. Reduces false positives and the wasteful investigations they entail. |
| Fully Integrated       | - Simple feedhandler integration supporting multiple venues, protocols and file types.  
Integrate with existing systems, data sources and processes.  
  - Native file system (import and export of CSV, XML and binary format files).  
  - ODBC (for connectivity to standard SQL databases).  
  - C/C++, C#, Java and other standard compiled programming languages.  
  - Matlab, R and other standard statistical tools as required.  
  - Excel and other data and text editors. |
| Customizable Alerts, Reports and Dashboards | - In addition to enterprise-defined views users can build their own Alerts dashboards and reports (subject to appropriate entitlements). Easily amendable parameter-driven views provide further end-user flexibility. |
| Kx Platform            | - Entitlements, access control, monitoring, audit and failover capabilities.  
- Connectivity framework that greatly simplifies interfaces to read data from market feeds and internal systems and publish them to internal consumers.  
- Workflow framework for assigning trading alerts to surveillance analysts, and to manage alerts through analysis, investigation and case creation. |

The solution provides the ability to monitor for HFT/Algorithmic trading activity using a set of predefined alerts based on frequency, ratios and other metrics. As an example of the solution’s flexibility these can be easily extended to deploy new, user-defined alerts based on other criteria and provide customized visualization.

Cross product, multi-market
Real-time and historical data
Calibration to improve alert quality
Adaptability for future requirements
Post-trade analysis capabilities

Kx for Surveillance is a CEP based solution, incorporating an expansive tick database including real-time and historical data, flexible alerts and dashboard visualization of results.
Alerts Management

Swift detection of unauthorized trading activity is vital, but rigorous follow-up and investigation is equally important. The ability to create, modify and track alerts is one of the key strengths of Kx for Surveillance.

A surveillance Alert is a piece of business logic defined by the client and is typically intended to detect certain types of market participant behavior. The process listens to market data and events arriving from the tickerplant, calculates statistics based on the incoming data, compares them to predefined benchmark values, and generates messages if threshold values are breached.

Alerts can be based on fixed or dynamically recalculated thresholds e.g. a 30 day average daily volume profile generated at the start of the day, or the current VWAP. Alternatively, an alert might monitor if the price of an instrument increases by more than x% from the opening price but the alert will only be raised for those instruments specified in a configuration parameter – making it easier to extend or restrict the coverage and sensitivity. This approach enable alerts to adjust to market conditions so that false positives associated with static or out-of-date threshold levels are minimized. Note that alerts may also be driven by the results of other alerts.

Investigating alerts

When an alert is fired users can look at the alert details (when and why it was fired) and surrounding information including unstructured data that may help in the investigation. For example tweets, emails etc. that may have been sent just in advance of what appears to be an opportunistic trade.

The alerts framework enables clients to:
- Develop new alerts, reports and dashboards in a sandbox environment using production data.
- Insulate the sandbox from the production system, so that no action within the sandbox may affect the production surveillance engine.
- Test and deploy the alerts and reports directly to production, once verified in the sandbox.
- Apply access control to ensure that only suitably qualified client personnel are permitted to develop, test and deploy such alerts and reports.
The alerts engine within the Surveillance architecture enables alerts to be grouped and triggered by common “events” (e.g. one alert engine might subscribe to trade changes, one to order changes, and yet another to news feed changes). There can be several instances of each type of alert engine, so there could be multiple trade alert engines (each subscribing to trades) allowing hundreds or thousands of different alerts to run in parallel in engines so the system may scale. The design and technology that enables this is based on Kx for Surveillance’s origin in the Algo trading world. Each alert engine can receive any required subset of market data and has access to any available static or configuration data. Given that the basis of the design comes from the algorithmic trading world, the alerts that are possible can be simple or arbitrarily complex.

<table>
<thead>
<tr>
<th>Name</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price Movement Alert</td>
<td>Identifies price movement anomalies interday, trade-to-trade and intraday which exceed threshold values or benchmarks for price impact trades. Thresholds are determined using parameters such as price level, market capitalization and number of samples available (taking into account corporate events), and can vary throughout the day depending on trading activity.</td>
</tr>
<tr>
<td>Volume</td>
<td>Identifies where there is an unusual volume traded in an instrument in a trading day, based on comparison to threshold values or benchmarks for all trades excluding information-only trades.</td>
</tr>
<tr>
<td>Broker and Security Market Cap</td>
<td>Compares the running total accumulated trade volume for the day in an instrument against a real-time dynamic market capitalization threshold taking into account previous alerts and the instrument’s free float shares on issue.</td>
</tr>
<tr>
<td>Extreme Trade Range</td>
<td>Identifies trading (price impact trades only) at unexpected and extreme price levels, ie: price moves greater than an absolute value or percentage away from the reference price at which the regulator considers a transaction is likely to impact market integrity.</td>
</tr>
<tr>
<td>Large Order</td>
<td>Identifies unusual large orders where both quantity and value for new orders exceed dynamic benchmarks (calculated daily from historical data) or pre-defined default thresholds.</td>
</tr>
<tr>
<td>High Order Rate</td>
<td>Alerts if a broker is submitting a large number of orders for a single security into an order book in a short time period. Identifies any potential &quot;quote stuffing&quot; and can also detect defective algorithms which place abnormal numbers of orders into the market.</td>
</tr>
<tr>
<td>Price Support / Marking the Close</td>
<td>Alerts when the price of an instrument is moved more than necessary around market close over a sustained period – a trading pattern synonymous with price support/marking the close.</td>
</tr>
<tr>
<td>Layering</td>
<td>Identifies when a participant enters orders to buy or sell which give a misleading impression of intent with a switch to the other side of the book.</td>
</tr>
<tr>
<td>Order to Trade Ratio</td>
<td>Alerts for new, replaced or cancelled (excluding restated) orders when orders for a single instrument by participant exceeds thresholds for order/trade ratio, order count and trade count.</td>
</tr>
<tr>
<td>Collusion</td>
<td>Alerts on instances of possible market collusion. The alert is subject to various configured parameters with lower and upper bounds on individual and collective traded volumes and trade counts.</td>
</tr>
<tr>
<td>Spoofing</td>
<td>Detects manipulation of the price of one instrument by using another instrument before the opening auction period.</td>
</tr>
<tr>
<td>Black Listed Trader</td>
<td>Surveys trades and orders for black listed participants at any of broker/account/secondary account levels.</td>
</tr>
<tr>
<td>Movement From Underlying</td>
<td>Identifies movements between futures and/or derivatives contract prices and their underlying asset/index prices which exceed threshold parameters.</td>
</tr>
</tbody>
</table>

All alerts are published and stored in the database along with the market data. Once alerts are published, they can be picked up by auxiliary processes and acted on. A usual approach is to display the alert in a dashboard, or generate an email notification.

With email notification there is an option to add associated text to provide further context and insight.
Market Replay

The challenge in trade surveillance is to keep pace with the miscreants and identifying where they are acting inappropriately. But like any disease they morph. They don’t live by the rules so the rules that seek to trap them may not always work. Sometimes, to identify previously unknown misdemeanors, to backtest rules designed to trap them or simply review the conditions surrounding an incident in the past the ability to replay market conditions can offer invaluable insight. Kx for Surveillance provides this ability though its market playback functionality.

Playback allows users to replay any data from both real-time and historical databases. The selected time and date range can be replayed from a single table, or simultaneously from multiple tables and can be at the original speed, or at a fraction or multiple of that speed. Sample use cases where market replay would be used include:

- Reconstructing events around a trade execution
- Stress testing new calculations or alerts
- Analyzing execution quality and regulatory compliance
- Selecting a time range to review the full price range of bids and offers
- Reconstructing a situation for analysis or training

In the screenshot above, the graph in the centre presents bids prices on the left and offers on the right. The leftmost panel presents all incoming trade events in the market (bids, asks, trade, amend, cancels etc.) along with time stamped data from unstructured sources like email and tweets. On the top a time horizon for the book in question is illustrated and the user then can drill down on any point in the order book by choosing (clicking on) a particular date and time which builds the book. The graphs show price and volume statistics and time-aligned corporate announcements. The central and top graphs can be dynamically changed to illustrate other aspects of the data - for example the topmost graph can be changed to show a spread view or the central graph can show a table of aggregated price points.

Data can be stepped through on a tick by tick basis or replayed at multiples of up to 50 events per second. In this way a user can create a reconstruction of what happened at each price level for the selected time and search for suspicious patterns, abnormalities or other indications of malicious intent.
Market replay can be particularly effective for backtesting and calibration of alerts by allowing surveillance analysts to test new alert algorithms against historical data and to parameterize alerts to minimize false positives. As new algorithms evolve, backtesting can be conducted to identify past market misconduct. The replay capability is based on techniques used by trading desks and proprietary trading desks to backtest their strategies by replaying selected historical data to another engine and running the alert rules/strategies against the replayed data. Kx Playback is a separate process within the product so it will not affect the performance of other processes within the architecture.

A tagging feature enables surveillance analysts to flag trading entities or trading data such that market data matching the tag criteria will be highlighted for easier tracking and reporting.

- Replay events to reproduce past market misconduct.
- Test new alerts and algorithms against historical data and recalibrate parameters to minimize false positives.
- Modify alert parameters in real time to adjust alert sensitivity to new market conditions.
- Shows all transactions as they occurred including orders, trades, news, security trading states, alerts.
- View emails, tweets and other unstructured data surrounding the events.
- Aggregate price/time order book display at a point in time, with drill down to all orders at a price point.
- Market summary including bid, offer, last, high, low, volume, value, change, change%.
- Monitor trading for a security for multiple markets or for a single market.
- Event log – showing a time series of all order actions including new orders, amends, cancels, trades, trading statuses, news, and alerts.
- Order book depth – reconstructs the order book at a point in time with ability to step through changes to the orderbook.
Case Management and Reporting

Once alerts have been raised, Kx for Surveillance provides additional functionality to ensure they are followed up on in a timely and orderly fashion. Each workflow item has a default user assigned and all workflow users fall into one of two user groups - read and execute. The former can view all alerts and the latter can evaluate and modify them according to the normal operational process.

Alert Workflow Items are managed by a single Workflow Engine. This provides a single point of access for viewing and modifying Alert Workflow Items. The workflow system is used to track and manage Alert Items that have been created by the system. Every Alert Item will generate an Alert Workflow Item (via the Workflow Initialization Analytic), which is used to track and annotate the alert. All workflows are entered in an "Open" state. From there they can transition to any of "Explained", "Watched", "Reassessed", "Discard" or "Review Listed". They can transition from any non-open state to any other non-open state. Any one of the non-open states is also considered a final state.

The permissions to read and execute workflow items are managed via dashboard entitlements - users of the read group can log into the Workflow Reading dashboard, members of the execute group can additionally log into the Workflow Execute dashboard. As users interact and make modifications to the Alert Workflow Items, the primary Workflow Engine will publish updates to each of the other Workflow Engines via the tickerplant, ensuring each Workflow Engine contains all updates. Workflow items do not by default carry over to the next day.

Where multiple users follow up on an alert the changes applied by the first user to submit the modification (NOT the first user to open the alert workflow Item) will be accepted and any subsequent modifications to the same modification number will be rejected. Kx for Surveillance can also integrate with third-party workflow and case management tools where requested by clients.

Kx for Surveillance provides an overview of alert workflow items, historically and in real-time. Alert statuses can be displayed graphically by a range of criteria such as analyst, alert class or asset symbols. Alert volume patterns can be portrayed graphically in time buckets and with accompanying metrics on handling response times.
Kx for Surveillance

Reports

In addition to alerts, Kx for Surveillance provides a robust framework for managing both ad hoc and scheduled reports across the organization using industry tools like BIRT and Crystal Reports. It can also use Kx Excel that provides a direct Excel-to-Kx query interface. Complex reports can be built up in Excel, and make use of the powerful analytical and graphical capabilities of Microsoft Excel.

Historical data is stored on disk and is typically arranged as one database partition per day. Within each partition, separate folders are kept per table column, and within each folder, individual files are stored on disk per ticker symbol.

In addition, daily summary data is stored within each daily partition, and whenever possible this is used in preference to accessing the raw table data. In a well-optimized hardware environment, and for queries that are limited to a small number of symbols and daily partitions, ad hoc polling queries will execute comfortably in sub-second times, measured in small multiples of 1/100 sec.

Some examples of standard reports are listed below:

<table>
<thead>
<tr>
<th>Report Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selected Deals - Final Allocation</td>
<td>Shows the final allocation for both sides of trades selected by date range and trade ID with a tagging facility to identify activity specific to participants and symbols of interest.</td>
</tr>
<tr>
<td>Selected Deals – Full History</td>
<td>Shows the full allocation history for both sides of trades selected by date range and trade ID with a tagging facility to identify activity specific to participants and symbols of interest.</td>
</tr>
<tr>
<td>Futures Trade Data</td>
<td>Shows details of all trades selected by date range, symbol, contract type, venue and broker with a tagging facility.</td>
</tr>
<tr>
<td>Allocation Report</td>
<td>Shows all trade allocations selected by date range, time period, allocation comment, account, side, venue and trade type with a tagging facility to identify activity specific to brokers and symbols of interest.</td>
</tr>
<tr>
<td>All Transactions</td>
<td>Lists all messages received from the market operator for a selected by date range, symbol, side and several other criteria, including participant/s, contract type and order ID with a tagging facility to identify activity specific to participants and orders of interest.</td>
</tr>
<tr>
<td>Suspicious Trading</td>
<td>Identifies trading that may be indicative of insider trading in a selected symbol within a date range and time period on a selected side of the book. It aggregates all trade information by account, secondary account and broker. A volume threshold is applied to minimize false positives and a tagging facility is available to identify activity specific to participants of interest.</td>
</tr>
<tr>
<td>Layering</td>
<td>Lists potential instances within a date range of the misleading act known as layering, where a trader enters several orders to improve the price of a contract to show false and/or misleading volume so that the trader can potentially trade the other side of the book at a favorable price.</td>
</tr>
<tr>
<td>Spoofing</td>
<td>Identifies and aggregates instances of large order spoofing, whereby a trader enters and deletes a number of large orders within the selected date range. This is an attempt to inflate the interest in a contract by entering false and misleading volume.</td>
</tr>
<tr>
<td>Collusion</td>
<td>Identifies the emergence of patterns between the activities of any two clients / traders on the basis of trade allocations, within the selected date range. Collusion is identified where parties are trading in the same as well as in the opposite direction.</td>
</tr>
<tr>
<td>Marking the Close – Orders</td>
<td>Identifies instances whereby a participant has attempted to influence the settlement price of an instrument by selecting new or modified orders where the price is set to a number of points away from last traded (or in the absence of a last traded price, the previous settlement price) in a selected number of seconds prior to the close of the last session in the selected trade date.</td>
</tr>
</tbody>
</table>

Additional reports cover areas such as: Pre-Open Activity, Crossing to the Exclusion, Pre-Arranged Trades, Wash Trades, Intent to Trade, Withdrawing Orders and Error Accounts.

Execution time is independent of the age of the data so the same query will run on 3-year-old daily data, for example, just as quickly as it will on 1-month-old daily data given similar disk access speeds for the data location. There may be multiple instances of the reporting engines. This architecture allows reports to be generated in parallel by multiple servers, which can themselves be deployed across different cores, virtual machines or even physical machines. The report engines are server processes and do not subscribe to the tickerplant for trading data, but can request trading data from both the RDB (real-time) and the HDB (historical) processes. This technology is at the heart of the design for our algo strategy engines.
**Additional Usage**

Having implemented Kx for Surveillance for its primary function – identifying unauthorized trading patterns – the framework, connectivity and functionality offer considerable additional enterprise benefits, most of which accrue from having created an integrated data warehouse upon which the surveillance engine is based.

The **Integrated Data Warehouse** makes data of multiple types and from multiple sources available in a high-performance database for other applications.

Harnessing the data within a Data Warehouse and the development platform on which Kx for Surveillance is based provides organizations with a highly valuable resource for creating additional applications in the areas of market maker monitoring, compliance, quantitative and econometric research, operations monitoring, HFT/Algo monitoring or any other bespoke requirement.

Kx for Surveillance is built upon Stream for Kx which provides CEP and data analytics capabilities for developing additional applications.

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**Integrated Data Warehouse Applications**

<table>
<thead>
<tr>
<th>Market Data and Analytics</th>
</tr>
</thead>
<tbody>
<tr>
<td>HFT Monitoring</td>
</tr>
<tr>
<td>Pre-trade Analysis</td>
</tr>
<tr>
<td>Market Simulations</td>
</tr>
<tr>
<td>Surveillance</td>
</tr>
<tr>
<td>Post-trade Analysis</td>
</tr>
<tr>
<td>Transaction Cost Analysis</td>
</tr>
<tr>
<td>Alert Profiling</td>
</tr>
</tbody>
</table>

**Consolidated Markets** - The market database centrally stores all trades, orders, market and depth data with each record tagged by "source", which means that the trades table stores trades from multiple market venues in one table. This tagging scheme allows simple retrieval, grouping and reporting either within or aggregated across markets.

**Order Book Recreation** - By capturing and persisting the raw data points, analytics can be created in the analytic library that enable the users to either snapshot the order book at a given time, or recreate the order book for a given stock. An order book engine is used to build (or rebuild) the order books, as ticks are published.

**Trading Calendar and Market Phases** - It is common for users to want to filter data depending on the source and type of data. Static information such as trading calendars, exchange opening hours, auction periods, etc. is stored centrally and pulled into each data engine–either at start-up time or on request. Server-side filters can be applied when the data is requested and updated/customized to optimize performance.
Backtesting

Regulators and exchanges are placing increasing focus on backtesting of trading strategies to ensure that they are robust and resilient to unexpected market conditions. Kx for Surveillance, by capturing and storing all market events, providing a playback facility and including an analytics library, caters for exactly this requirement.

<table>
<thead>
<tr>
<th>Speed Flexibility</th>
<th>Analyze</th>
<th>Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Data storage optimized for high-volume, high-frequency and unevenly spaced tick data</td>
<td>• Comprehensive results via Results Analysis Module (RAM)</td>
<td>• Exchange simulation functionality maintains a virtual order queue to determine likelihood of fills and better represent real-world behavior</td>
</tr>
<tr>
<td>• The ability to load data from disparate sources in either real time or on a controlled batch basis</td>
<td>• Archive results for future analysis</td>
<td>• Exchange simulator logic can be extended and modified for different venues with different priority rules</td>
</tr>
<tr>
<td>• In-memory storage delivers unrivaled performance</td>
<td>• Easy to use SQL variant specifically designed to facilitate complex statistical analysis of time-series data, in real time</td>
<td>• Excel interface and easily configurable rich GUIs to visualize data and results</td>
</tr>
<tr>
<td>• Slow down or speed up data delivery speed to facilitate strategy testing</td>
<td>• Open interfaces allow external interfaces with analytics written in (for example) C++ or MATLAB to be used</td>
<td>• Provide derived and aggregated data during the capture and distribution process</td>
</tr>
<tr>
<td>• Flexible query mechanisms; simple to set up and use</td>
<td>• Comprehensives results via Results Analysis Module (RAM)</td>
<td>• Exchange simulation functionality maintains a virtual order queue to determine likelihood of fills and better represent real-world behavior</td>
</tr>
</tbody>
</table>

The Backtesting Process

• **Replay historical orders** for entire market or selected instruments.
• Create **simulated orders** around a reference price (background noise).
• **Adjusted historical replay** with "price adjustments" upon market shifts from by other strategies.
• Create **Market Shocks** (e.g. Take financials down 5% etc.)
• Run **multiple simulations** to create **P/L distributions** over multiple scenarios
• **Profile and analyze** the performance of any given trading strategy / algorithm against a given set of metrics.
• Use Kx for Surveillance’s **analytical tools** and a rich set of query interfaces to provide insight about trading strategies **risk and performance**.

- Proven technology meets the most demanding backtesting requirements from both a functional and technical perspective.
- Reliable, long-term storage of high volumes of data.
- Copes with large numbers of concurrent complex queries while simultaneously capturing hundreds of thousands of ticks per second.
- Scalability is constrained only by the hardware.
- Available – accommodates various high-availability configurations.
- Platform and hardware agnostic – not tied to one operating system or storagesolution.
Sample Alerts

Kx for Surveillance supports a comprehensive list of regulatory alerts and reports. Below are some illustrations:

<table>
<thead>
<tr>
<th>Sample of Out-of-the-Box Alerts provided for MiFID and MiFIR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Abnormal Squares</td>
</tr>
<tr>
<td>5. Client Front Running Inappropriate Front Running</td>
</tr>
<tr>
<td>7. Coordinated Trading - Buy</td>
</tr>
<tr>
<td>8. Cross Trading - Wash Trade</td>
</tr>
<tr>
<td>10. Differentiation - Benchmark - Related Instruments</td>
</tr>
<tr>
<td>11._front_running</td>
</tr>
<tr>
<td>12. Front Running - High Order Stop</td>
</tr>
<tr>
<td>13. Front Running - Orders</td>
</tr>
<tr>
<td>15. Inappropriate Assignment - Client Orders</td>
</tr>
<tr>
<td>16. Inappropriate Assignment - Client Orders</td>
</tr>
<tr>
<td>17. Large Orders</td>
</tr>
</tbody>
</table>

A Sample of Supported Alerts

Alerts can be easily re-defined and recalibrated to accommodate evolving trading patterns and changing regulatory requirements.
Kx for Surveillance

In the Press

ASIC selects Kx for Streams to provide next generation market surveillance solution

Kx for Surveillance: A leader in high-performance database and time-series analytics, today announces that it has signed a multi-year annual software license with the Australian Securities and Investment Commission (ASIC) to implement its Kx for Surveillance solution for the design, development and hosting of ASIC's new market surveillance system.

Kx for Streams will be used by ASIC in meeting its statutory obligation to oversee Australia’s licensed financial markets. In particular, Kx for Streams will be integral to ASIC’s market surveillance activities, enabling detection of trading anomalies and irregularities that may indicate disorderly or prohibited trading across the range of asset classes and product trades. This capability monitors various instrument types in different asset classes like equities and fixed income, highlights the strength of the Kx suite in dealing with large data volumes at high velocity within a single platform, i.e. its ability to address the “big data” challenge.

Kx for Streams was chosen by ASIC as the preferred solution, robust and technologically advanced solution to deal with the ever complex nature of trading, which is characterized by faster trade speeds, increased trade and order volumes, and increased volatility. These market features have made detecting and investigating market misconduct increasingly complex.

Commenting on the contract win, Kx CEO, Brian Conlon said "We are delighted with the decision by ASIC to use Kx for Streams as its market surveillance platform for market surveillance. Kx for Streams will allow ASIC to address its need for increased market surveillance tools. The superior performance and technical capabilities of our professional services teams leave us ideally placed to design and manage the hosting of this solution and to partner with ASIC in developing analytics to help maintain efficient and orderly markets.

ASIC said that the new system would enable its market surveillance team to interrogate very large data sets, and monitor market activity in a manner consistent with the increased use of technology in day-to-day trading.

About Kx

Founded in 1993, Kx is the provider of Kx® , a time-series database for performance-critical environments. Its technology is widely adopted by financial institutions around the world, including Morgan Stanley, HSBC, Citibank, Goldman Sachs and JPM. The company counts the top ten global investment banks among its customers, many of whom deploy Kx as their enterprise-wide market data server.

Kx wins Market Surveillance System of the Year Award

Kx wins Market Surveillance System of the Year Award at the World of Futures and Options show in Asia.

Now in its third year, the FOW Awards are designed to recognize the leaders in the capital markets industry in Asia. Kx for Surveillance responds to the needs for regulators and exchanges to be at the fast and in Asia. Kx for Surveillance responds to the needs for regulators and exchanges to be at the fast and in Asia.
FD Corporate
FD is a leading provider of software solutions and consulting services to the capital markets industry. Founded in 1996, it occupies a niche market position in terms of deep domain knowledge and technical expertise. Headquartered in Ireland, FD has a global presence with offices across EMEA, the Americas and Asia Pacific.

- Publicly held company on London Stock Exchange (LSE FDP.L)
- Headquartered in Newry, Co. Down, N Ireland
- 2,000+ employees worldwide

Consulting Services:
- Multi-Vendor Services – Calypso, Murex, Wall Street, Summit, Opics...
- Legal, Regulatory and Compliance
- Data Management
- Software Development
- Big Data and Data Science

Big Data Solutions:
- Stream for Kx – high-volume data capture, analysis and distribution
- Kx for Flow – Foreign Exchange trading
- Kx for Algo – low-latency trading strategies and execution
- Kx for Surveillance – for regulators, exchanges and brokers
EMEA

Head Office
3 Canal Quay,
Newry,
BT35 6BP
N. Ireland
Tel: +44 (0)28 3025 2242

Belfast
11-13 Gloucester Street,
BT1 4LS
N. Ireland
Tel:+44 (0)28 9023 3518

Dublin
Fleming Court,
D04 N4X9
Rep. of Ireland
Tel: +353 (0)1 630 7700

London
Cannon Green Building,
1 Suffolk Lane,
EC4R 0AY
United Kingdom
Tel:+44 (0)207 3371210

Americas

New York
45 Broadway,
New York,
NY 10006
USA
Tel:+1 (212) 447 6700

Toronto
31 Lakeshore Rd East
Mississauga, On,
L5G 4V5
Canada
Tel: +1 (905) 278 9444

Ottawa
300 Terry Fox Drive,
Kanata, On,
K2K 0E3
Canada
Tel: +1 (613) 216 9095

Palo Alto
#375
555 Bryant Street,
CA 94301
USA
Tel: +1 (650) 798 5155

APAC

Sydney
22 Pitt Street,
Sydney,
NSW 2000
Australia
Tel: +61 (0) 2 9236 5700

Singapore
One Raffles Quay,
North Tower,
#30-03
Singapore
048583
Tel: +65 6592 1960

Hong Kong
Level 66,
The Center,
99 Queens Road Central,
Central,
Hong Kong
Tel: +852 2168 0715

Tokyo
Sanno Park Tower,
2-11-1 Nagata-cho,
Chiyoda-ku,
100-6162
Japan
Tel:+81 (0)36 205 3494

www.kx.com

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