Dashboards for Kx
Product Overview
Dashboards for Kx provides a powerful, lightweight presentation layer for real-time and historical data stored in Kx and other databases

Harness the skills of your organization with Dashboards for Kx. Discover new opportunities in your data; take advantage of a full suite of tools with OLAP tables, multi-charts, maps and more. In-built custom components offer ready-made surveillance, tick-driven financial charts, and alerting solutions.

One of the defining characteristics of the Big Data world approach is its “store everything” principle on the premise that the as yet unknown relationships, correlations and insights it contains may be discovered later. But rather than waiting for data scientists of the future using algorithms and arcane formulae to unearth its hidden potential, Dashboards enable end-users to unlock its value – today. Using an array of tools like bubble charts to detect trends in volume, heat maps to view their distribution and drilldown to view their detail, Dashboards for Kx empowers users to explore, visualize and experiment with data in a flexible and intuitive manner.

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 customised 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.

Dashboards for Kx deliver stunning visuals to bring your data to life. Building dashboards has never been easier; with no programming experience required your first dashboard can be built in minutes. Customization is made simple, from ready-made color palettes to optional CSS and HTML formatting, there is something for everybody. Dashboards for Kx bring ideas and data together in simple harmony.
Dashboards for Kx Overview

Dashboards for Kx provide rich visualization of both real-time streaming data and highly optimized polled queries on intra-day and historical data. Completely configurable, Dashboards for Kx enable clients to quickly build powerful grids and charts of the underlying data stored within Kx and other databases. They enable users to explore data, create ad-hoc queries and share results with others - or export to excel for further analysis. Moreover it can be done without the need for specialist q programming skills. Charts and displays can be parameter driven for ease of use and flexibility and multiple dashboards and can also be linked to make drilldown and data investigation quicker and easier. Dashboards remove the restriction to exploring Big Data and enable organizations to unlock the value of the data they store.

Rich Visualization Experience
Wide range of interactive display options – heat maps, bar graphs, tree maps, candlestick graphs, pie charts, dot plots, spread graphs and more. Advanced data filtering, sorting, paging and user configurability.

High Volume Streaming Data
Dashboards for Kx can handle hundreds of thousands of streaming records per second without degradation in performance by using the unrivalled power of the underlying Kx database.

Role based views and access levels
Visual query builder

Subscription Mode
Optimized for streaming data. Throttling, conflation by time intervals with server side caching to support multiple users and achieve enterprise level scalability.

Real-time and historical data
Real-time/OLAP

Low Latency
Ultra low latency from using Kx technology enables Dashboards for Kx to accommodate high data volumes at high speed and high availability – and in real-time.

Low latency
Complex queries
Excel plugins

Parameter driven & chart linking

Entitlements framework

Poll real-time data
Flexible layout and formatting

Sample Usage Patterns

<table>
<thead>
<tr>
<th>Business Users</th>
<th>Technical Users</th>
<th>Power Users</th>
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<tbody>
<tr>
<td>Viewing, and exploring data for critical indicators of business health (e.g. monthly profit and loss, revenue, trading activity). Drilldown into the data, slicing and dicing to deeply analyze the numbers (e.g. risk by customer, profit by currency).</td>
<td>Constructing dashboards of complex analytics on backend database, and making these available throughout the enterprise. Building streaming queries that are published to any number of concurrent dashboards, with minimal load on the server or the network</td>
<td>Creating complex interactive queries using the library of widgets for selection: drop-down lists, date pickers, free text forms. Creating views, monitoring trends to identify trading signals, risk thresholds and other actionable indicators</td>
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Why Dashboards for Kx

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Dashboards for Kx</th>
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<tbody>
<tr>
<td>Ability to support extremely high data volumes</td>
<td>Other solutions are unable to sustain the high data throughput and real-time capability of a Kx implementation. Within Dashboards for Kx, it has created a very sophisticated throttling/confiation mechanism to cater for such volumes.</td>
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</tbody>
</table>
| Easier Faster Queries                             | • Provides OLAP queries and dynamic drilldowns (eg, by country/customer/product/month to product/month/country/customer)  
|                                                  | • Drag and drop capability                                                      |
|                                                  | • Users can create these OLAP queries on the fly and do not need pre-canned data or cubes. |
| Flexibility                                      | Dashboards include a plug-in framework so customers can build their own apps.     |
| Kx Resources                                     | Kx has a pool of talented resources to understand and assist in configuring complex requirements, eg: queries where a gateway may be involved. |
| Continued development and R&D                    | Kx has invested heavily in R&D to make its Dashboards extend to multiple database technologies over JDBC and continues development with Hadoop, NoSQL and technologies such as Pivotal (HBase, Greenplum), MongoDB, Cloudera .. |
| Entitlements and Audit                            | The Dashboard permissions and entitlements framework is inherited from Kx Enterprise and imposes strong governance around creating, editing and viewing apps. |

Dashboards for Kx USP: Ability to Action items
The dashboards are integrated with our reporting and case management/workflow applications enabling sophisticated actions to be launched from dashboard data and action buttons:
Start a process, Alert a user, Send a report,

Buy v Build Considerations:
There is little debate about the value of a visualization layer - it is generally recognised as the optimum means of interpreting, exploring and communicating data. What is more often debated is whether to buy or build the capability - which is quicker to deliver, costs less, works better, offers more? Which is more likely to succeed, and continue to succeed? In answering these question and assessing which will ultimately have a lower total cost of ownership it is important to consider the practical implementation steps in a build decision

Development
Building UI layer components (charting graphing widgets ...)
Connectivity
Develop API for connection between FE to Data layer
Testing
Performance
Multi user Scalability / Concurrency / load balancing
Developing an access control and entitlements framework
Product and platform upgrades
Support and maintenance
R&D

Implementation

Management

Kx maintains a dedicated team to continually assess advances in hardware, infrastructure and GUI technologies and refines algorithm processes and methodologies in order to improve the Volume and Velocity of our technology We continually review and upgrade our technology stack so that we keep abreast and take advantage of innovations and new breakthroughs on the technology front.
Architecture

Dashboards are a component of Kx platform designed for developing, deploying and maintaining Kx based solutions, but can deployed on a standalone basis for accessing and viewing data from other data stores.

Control for Kx provides a centralized development, configuration and runtime management functionality. It also provides core enterprise functionality which is used by the Application Layer.

A supporting application layer comprises a rich set of processes and analytics that perform all the key tasks required from an enterprise tick processing and capture solution.

At the heart of the solution is the high-performance Kx database for processing for both real-time and historical data. The that combines the functionality of CEP engines, in-memory databases and analytic databases for capturing, storing and analyzing.

**Dashboard Frontend:** A highly configurable, thin client application that provides a rich visualization and querying layer onto large volume datasets.

**Dashboard Control:** A rich configuration and administration management system providing a repository for all Dashboards configurations and queries.

**Dashboard Server:** A resilient, scalable back end web server component that handles all the connectivity and administration functionality.

**Dashboard SDK:** A flexible and extendible set of APIs that allow the Dashboards for Kx functionality to be enhanced and extended.

**Dashboard Query Manager:** highly optimized access to back end data stores reducing load and bandwidth both on the data tier and the client side.
Dashboards for Kx are not restricted to Kx databases only. By interfacing with other data sources and other data display technologies it is possible to create even richer visualizations of enterprise-wide data.

**Multiple Data Sources**
Dashboards for Kx can connect to and query any JDBC-enabled database. Many are supported out of the box (Oracle 12, MySQL 5.0, SQL Server…) and others can be configured by simply adding the required JDBC driver and specifying the standard host, port, SID connection parameters along with login parameters.

**Other Data Display Technologies**
The screenshot below illustrates how Dashboards for Kx can integrate with geographical mapping technologies such as Open Street Maps, Microsoft Virtual Earth, Map Quests, Yahoo Maps etc to give better insights into data.

In this case census data is shown in tabular form in the bottom table and simultaneously presented in a combined heat map and bubble map where the sizes of the circles illustrate the change in population and the color conveys the actual population (graduated from blue to red).

Users can amend what details are mapped on screen (selecting, say, "% House ownership" instead) and how the indicators are used (changing colors for instance)

**Geo-tagging** can also be applied to augment and relate data sets – in this case data on the distribution of customer ages and the number of active trading accounts they operate can be overlaid so that clicking on a location presents a summary profile of that data point. This makes it easier to explore data and look for trends or anomalies.
Graphical Features

Charts in Dashboards for Kx are highly customizable and even most complex views on data can be configured in just a number of clicks. Once created they enable further user interaction including:

- Drilldown into results by double clicking in a row of data
- Slice and dice the underlying data by dragging the column names across the breadcrumb trail and pivoting on key dimensions
- Support for complex parameterized queries making it easier to explore and analyze data sets
- Quick access to aggregated and summary information for strategic analysis

<table>
<thead>
<tr>
<th>Charts and Graphs: Key Features</th>
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<tbody>
<tr>
<td><strong>Overlaid Charts</strong> Line, Area, Plot, Column, Candle and Bubble charts can be overlaid to view different chart types along the x-axis and up to two y-axis ranges.</td>
</tr>
<tr>
<td><strong>Display Options</strong> Various label, legend and axis rendering options allow the graph display to be customized in a large amount of ways.</td>
</tr>
<tr>
<td><strong>Clickable data points</strong> Data points can be selected and used to populate parameters on other applications much in the same manner as clicking on row/rows in a data grid.</td>
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<tr>
<td><strong>Zooming</strong> is available in charts when increased resolution is required on the data.</td>
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<tr>
<td><strong>Parameterization</strong> Charts can be parameter driven to give extra flexibility and ease of user to users</td>
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</table>

Chart types include: Line, Area, Plot, Bar, Column, Pie, Candle, Bubble, Heat Map, Tree Map...

Additional functionality to enhance the presentation and interpretation of results includes:

**Sorting and Filtering**
- Multi column sort is available on grid view and Complex string and arithmetic filtering

**Summary Rows**
- A summary row can be added to include the aggregations such as Sum, Min, Max or Average.

**Text Formatting**
- Colour and font options can be used to format the display to emphasize important data. Other formatting including currency formatting, rounding and precision also ensures data is easy to read.

**Conditional Highlighting**
- Data returned can be monitored and compared to pre-configured limits. Visual and audio cues can then be used to monitor key metrics in the data. Visual cues include: filled cells, colour text, font options, icons

**Sound Alerts**
- Data returned can be monitored and compared to pre-configured limits. Sound Alerts can be added to monitor key metrics in the data.

**Date pickers and dropdowns**
- When data is best viewed as a list or date, it can be displayed as a dropdown or date picker. These components can be used to populate parameters in other applications.
OLAP

Online Analytic Processing (OLAP) enables users to dynamically interact with data sets to explore and analyze their content – typically via slicing and dicing data across different dimension by various criteria. Its distinguishing characteristics are that it is non-transactional and multi-dimensional, and generally provides quick access to aggregated information for strategic analysis.

Dashboards for Kx provide OLAP functionality to view massive volumes of real-time and historical data. This enables users retrieve data, define views and create graphs dynamically and drilldown to individual records. This obviates any requirement to have had the data pre-processed in advance thereby opening the entire dataset to analysis (subject to appropriate entitlements) yet without negatively affecting system performance. Users can slice and dice data to better understand relationships, link individual displays and add summary counts such as totals, averages and other aggregate measures to add value to and give insight into large data sets.

The Dashboard on the left tracks the flow of trades between brokers on an exchange. At the top and middle sections of the display the data is presented in a tabular format detailing the amount of orders, total trades and total value. This is subsequently broken down by broker, average trade, average order, ratio, highest and total value. The bar chart on the right shows the percentage of trades over the last 5 days by broker. Finally, the chart at the bottom combines a bar chart with a line graph to allow the user to view information on a time series basis alongside overall trends on a historical basis.

Some of the OLAP features provided include:

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
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<tbody>
<tr>
<td>Sparsely populated OLAP cube built and managed in real-time</td>
<td>Dashboards for Kx manage a set of sparsely-populated OLAP cubes on demand, built from the underlying datasets. The OLAP cube receives streaming updates in real time. Dashboards for Kx’ unparalleled ability to build cubes in real time dispenses with any need for costly pre-aggregation giving users the power to immediately slice and dice enormous volumes of tick data.</td>
</tr>
<tr>
<td>Server side Group, Filter, Pivot</td>
<td>Aggregation and other data transformations are performed server-side, directly on the database. This means that Dashboards for Kx are uniquely suitable for delivering OLAP processing of the large volumes of data commonly found in financial tick databases.</td>
</tr>
<tr>
<td>Multiple drilldown levels</td>
<td>The builder of the dashboard selects an ordered list of dimensions from the schema. This list is used to control how a user can drill down into the data.</td>
</tr>
<tr>
<td>Date Range Filter Optimization</td>
<td>In keeping with Kx best practice OLAP queries are optimized to query only within the required date range.</td>
</tr>
<tr>
<td>Drag and drop reordering of drilldown dimensions</td>
<td>Users can reorder their OLAP views simply by dragging the name of the dimension to the top of the breadcrumb trail, slicing and dicing the OLAP cube in any combination. This rebuilds the OLAP cube from the underlying data in real time rather than just rendering a different set of pre-aggregated values.</td>
</tr>
<tr>
<td>Built in Monadic Aggregate Functions</td>
<td>Built in: Sum, Count, First, Last, Min, Max, Average, Variance, Standard Deviation.</td>
</tr>
<tr>
<td>Custom Aggregate Functions, including non-Monadic functions</td>
<td>Supports user custom aggregate functions. These are applied to the query, and executed on the server side q functional expression, which can be an aggregate function of arbitrary complexity. E.g. vwap calculation based on 2 result set columns</td>
</tr>
<tr>
<td>Pivot Columns</td>
<td>Supports selection of one or more pivot columns.</td>
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</table>
**Linking Graphs**

Container applications provide the ability to combine number graphs and data grids into a single display and to link them together for drilldown purposes. This makes it easy to present large tables of data but also make it easy to examine each entry in detail: for example a list of book P&Ls may be displayed with adjacent apps that show its history, daily transaction and individual trader contribution. It is also possible to link grids, graphs and datasets to so that multiple graphical views of the dataset are visible at the same time and drilling down on one of the views initiate simultaneous drilldown on all linked views.

<table>
<thead>
<tr>
<th>Two way linking on drilldown/rollup</th>
<th>Drilling down on parent OR any child causes simultaneous drilldown on parent and all children.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two way linking on breadcrumb drag/drop</td>
<td>Breadcrumb drag/drop on parent OR any child causes simultaneous redraw on parent and all children.</td>
</tr>
<tr>
<td>Supports one parent to many children</td>
<td>One OLAP parent app connected to unlimited datasource target apps.</td>
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</tbody>
</table>

This is illustrated in the example below designed for analysing High Frequency Trading activity. The two heat maps on the top left display the order-trade ratio and the percentage of aggressive trades by broker.

The Bubble app in the centre of the dashboard selects all those who had a near 1 to 1 ratio on their quantity bought and sold - an indication of HFT activity. The colour on the bubble chart indicates the profit or loss incurred during the day. Clicking on any of the blocks, columns or bubbles populates the dashboards underneath.

For example, clicking on a broker name provides an overview of each security bought/sold.

By clicking further on the largest bubble in the volume turnover view we can get further insight into the data – in this case that broker traded only one security – but in very high volumes.
Creating Dashboards

Dashboards comprise a collection of applications, or “Apps” that contain all the details required to retrieve and display your chosen information in your preferred format. Apps provide a means of bringing together information from across multiple different databases in different locations into one unified visual space. The steps in creating a dashboard are simple:

- **Name**: Users enter a dashboard name and an optional description that will be displayed in the title bar.
- **Entitlements**: Dashboard entitlements are specified by selecting the groups who can access it and specifying their read/write access rights.
- **Content**: A list of available Apps is presented from which the user can select which ones to include in the Dashboard - or this can be done from within the dashboard itself.
- **Editing**: Once within a dashboard a user has functionality to add and remove apps. They also have the ability to create a copy of an existing dashboard. When creating a copy the user can either include the existing apps and benefits from all changes made to them or the user may elect to have a duplicate created that can be independently managed thereafter.

When creating dashboards user can specify whether they will operate in Polling mode (i.e. requesting data at regular intervals from a database) or in Subscriber mode (i.e connecting to streaming tables on a ticker plant to provide real-time updates).

**Creating Apps** for inclusion in dashboard is also easy and intuitive with Tabs to guide users in their set-up and maintenance.

- **Query**: This tab is used to create the queries used by dashboard applications. It can also be used to create server side filters that reduce the amount of unnecessary data being sent to the dashboard and export/report.
- **Graph**: Dashboards for Kx supports the creation of a wide range charts and graphs the specification of these graphs and charts is done through the Graph tab.
- **Highlights**: Conditional Formatting is accessed from the Highlights tab. The highlight options can be configured to flash visual alerts when an interesting condition occurs, or to highlight critical values as needing attention.
- **Entitlements**: Providing permissions to control the applications read, write permissions to individual user groups.

**Formatting** - There are a wide range of formatting options that can be applied to the data grid view.

**Actions & Commands** - Actions and commands, are used to pass data between apps on a dashboard.

**Processes** - Processes provide the ability to call a predefined q script and pass parameters from dashboards.

**Info Panels** allow the user to provide post-it note information on any Dashboard.
Dashboard Administration

Dashboards for Kx leverage features of the Kx Enterprise Edition platform to provide administration and control capabilities required by enterprise applications.

Authentication and Entitlements
Administrators can define entitlements and permissions at both user and group level. Entity Groups can be defined that group together sets of Dashboards or individual Dashboard Apps. User or user group entitlements can then be assigned to confer no access, full access or read only access. Interfaces are available for integration with LDAP and other security mechanisms to enable implementation-specific Single Sign On implementations.

Administrator
Dashboards for Kx provide a number of tools that Administrators can use to set up and maintain the system. An administrator can manage user accounts and group permission for dashboards and applications.

- Session Control: Administrators can set limits on the number of times a user can log in, configured individually by username. Administrator can view all open user client sessions and remotely close any user session.
- User Management: User and group accounts can be created, deleted and managed through a simple UI.
- Database Connections: Manage database connections and database connection groups.
- Dashboards editing: Administration screen supports bulk editing of dashboards and applications.

Monitoring and Logging
Administrators have access to a number of monitoring and logging options including:

- Login audit trail: All login attempts, failed or successful are logged in audit trail tables at the database layer, with details of username, time, IP address etc.
- Query audit trail: All queries are logged in audit trail tables at the database layer, with details of query, parameters, time, IP address etc.
- All queries passing through the Kx Server Layer are additionally logged to file.
- Keystroke audit trail: All keystrokes and button pressed occurring in the Dashboards for Kx Client are logged, and sent to the Kx Server Layer where they are logged to file.

Backup and Version Control
To facilitate swift backup and simplify version control on Dashboards deployed throughout the enterprise the file and settings are made easy to access, store and isolate:

- Binary Files - All settings are stored in binary files under a single directory. This can be zipped and versioned to maintain an archive of the complete configuration at any time.
- q command archive - Settings for each application, dashboard and other Dashboards components are stored as q command files. Changes to settings are therefore visible in a command line tool and changes can be merged as required.
- Dashboards export - A single dashboard can be exported to XML file and imported on a separate Dashboards deployment. These files can also be managed through version control.
Sample Dashboards

FX Trader Dashboard

At the top of this FX trader screen the user has selected three strategies that they would like to view in parallel. An alerts module enables the user to visualize the continuous change in data that they have requested. On the right, a table displays the bid and ask prices of the different FX pairs. The table at the bottom allows the user to view the order status of each strategy. Lastly, a line graph enables bid/ask midpoints to be viewed by exchange.

Alerts Summary Dashboard

This Alert Summary dashboard provides functionality to view, filter and analyze all alerts raised. Bar charts enable users to view the status of alerts by symbol, by user and by alert type. These can be further filtered by time period with an accompanying drilldown to the content of each alert. This enables the user to view patterns and detect trends in the alert profile. The visibility from overview to detail enables organizations to better manage and assess alerts and their underlying causes.
Analysis Dashboard – Regression Profiles

This sample Regression Analysis dashboard enables users to view graphical and tabular data of stock return analyzes. Bar charts display the beta of a series of stocks against an index over a chosen timeframe. The user can view regression statistics in tabular form. In addition, for the selected stocks, the user can view scatterplots of returns against a chosen benchmark and against one another, complete with confidence bands.

Status Monitoring Dashboard

The Dashboard on the right allows the user to track server level signals: CPU and memory usage. On the left hand side the parameters of the dashboard have been created enabling the user to drill down to the granular component level that is required. The middle section of the display is the alerts monitor that provides an interactive analysis to ensure that the information is displayed in a high impact visual fashion. The data on the right is presented in a tabular format and can be custom sorted by the user to run as requested.
Buy/Sell Strategy Dashboard

The Dashboard on the right tracks the efficiency of buy and sell strategies over a range of market prices. It overlays tabular data to provide detailed information at each point with line graphs to illustrate overall trends. It also includes bubble charts that give further information at each point along the curve by illustrating relative P/L amounts. A simple bar chart on the bottom left provides a quick and intuitive summary of volumes over time.

Liquidity Provider Pricing Time Series

Line Graphs are a great way to illustrate important comparative information about changes in data over a particular time period. The line graph on the left is displaying a pricing time series. We are showing the change in spread for a particular currency pair (TRY/JPY) from each of the liquidity providers streaming that price over a given time period. The controls at the top of the graph allow users to break down exactly the information they require. They are an excellent visualization tool that can be constructed in minutes.
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.

- Publically held company on London Stock Exchange (LSE FDP.L)
- Headquartered in Newry, Co. Down, N Ireland
- 1500+ employees worldwide

On Site, On Shore, Near Shore Delivery Options

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:
- Streams for Kx – high-volume data capture, analysis and distribution
- Kx for Flow – Foreign Exchange trading
- Kx for Algos – low-latency trading strategies and execution
- Kx for Surveillance – for regulators, exchanges and brokers
- Kx for AlgoLab – testing, validating and profiling algorithmic trading strategies