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StreamBase White Paper
Real-Time Profit & Loss

- Can Real-Time Profit and Loss tame
  the turbulent markets?

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Motivation for Real-Time Profit & Loss

The financial markets are accelerating: transaction volumes are up, latencies are down, complex cross asset trading up, revenue margins down. Recently markets have seen sudden spikes in volumes, and nervous volatility when the old rules of thumb broke down. Technology and global regulators have both changed those rules by increasing transparency, intensifying competition, and multiplying e-commerce relationships exponentially. Reforms such as Reg NMS in the US and MiFID in Europe have further increased the pressure, along with Basel II and the fair value accounting rules of the new International Financial Reporting Standards (IFRS). The IFRS require, for example, firms to mark more of their assets and liabilities to market, while Basel II is much more explicit about risk adjusted capital reserves needed. Now, when markets move, traders need to catch them on-the-fly to cut their losses and go with the flow to ensure compliance with all the rules and customer mandates. The difference between just-in-time and just-too-late has just become bigger.

It was not so long ago when daily profit and loss (P&L) and risk evaluations were state of the art. In a multicurrency world with ever more automated robotraders and instant, electronic global news, they are now painfully slow. This impacts not only the high frequency traders or global market makers trying to balance thousands of real-time orders and quotes against a flood of market data with awesome peaks at tens or hundreds of thousands of messages per second.

Now the credit squeeze of 2007 has renewed the focus on costs and risk. It demonstrated that some firms can lose billions in a single day, algorithmic trading systems can get confused in highly volatile markets, and end of day positions may mask serious intraday exposures. So now even traditional investment managers are keen to optimise their trading performance and track the impact of intraday movements and fluctuating daylight exposures. If risk can change by the second, traders, investment managers and compliance officers too need to track their P&L in real-time in order to provide a sensible framework for judging risk as a key factor in making trading decisions during the day. Not to have at least some idea of intraday performance is like flying blind.

Of course, some trading tools and broker algorithms already have real-time analytics. However, these all work differently and firms typically employ multiple solutions and lack ways to integrate them into a cross-platform view of risk. In addition, the increased adoption of cross-asset trading further complicates the real-time risk picture, and motivates the need to assess P&L across the enterprise.

So one critical question facing today's investment managers is: Is such a firm-wide portfolio map, marked to market in real-time, really feasible? Would it not absorb huge amounts of technology resources and be meaningless anyway, due to insufficient or stale market data? Would not the overhead of software maintenance inhibit innovation and the trading of new asset types like credit default or volatility swaps, so helpful for total return funds? The answer is unequivocally yes.

Agile investment firms are in fact demonstrating that Real-Time Profit and Loss is not only feasible, but highly lucrative as well. It opens up investment opportunities and trading styles, which might otherwise be excluded as too risky or too demanding in resources.

New technologies like complex event processing (CEP), applied as a "white box" system for Real-Time Profit and Loss, have turned tracking real-time market movements into a practical proposition for ordinary firms. They can also play a key role in easing the transition to fragmented markets with their notorious dark pools and to the complex array of order, execution and liquidity management systems to support them.

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The Market Requirements

Today's trader execution environment involves orchestrating many different broker, market, and in-house platforms, typically with multiple execution management (EMS) or order management systems (OMS) dedicated to different asset classes (see figure below).

Consolidated and direct feeds from firms like Reuters, Bloomberg, Comstock and the Exchanges and ECN platforms need to be integrated along with specialist broker and in-house feeds; and they need to be distributed to the appropriate analytical and trading systems. Trades too need to be tracked, not just back to orders but allocated to underlying instruments, portfolios and strategies if they are to inform decisions. OTC transactions may not be fully automated, so data collection for Real-Time Profit and Loss will also need to link into the appropriate work-flow processes within the firm.

Some traders are even integrating elementized news feeds as well as reference data feeds like corporate action announcements into their pricing systems. These can be XML feeds from the news wire services to pull out and tag key event data or market sentiment indicators from the articles themselves.

For complex instruments, pricing models mediate the data streams to value them based on market reference prices. Indeed there are cases where multiple valuation sources are employed and these need to be cleansed of errors or outliers, normalised and harmonised into a consistent set of prices to be used for the P&L. Often, foreign exchange translations are needed to bring all values into the firm's reporting currency.

The P&L system next aggregates all the valuations and compares them to various baselines to work out the relative gains and losses. These can be rolled up to the book, strategy or portfolio level, and the firm may then apply alert or market signal filters.
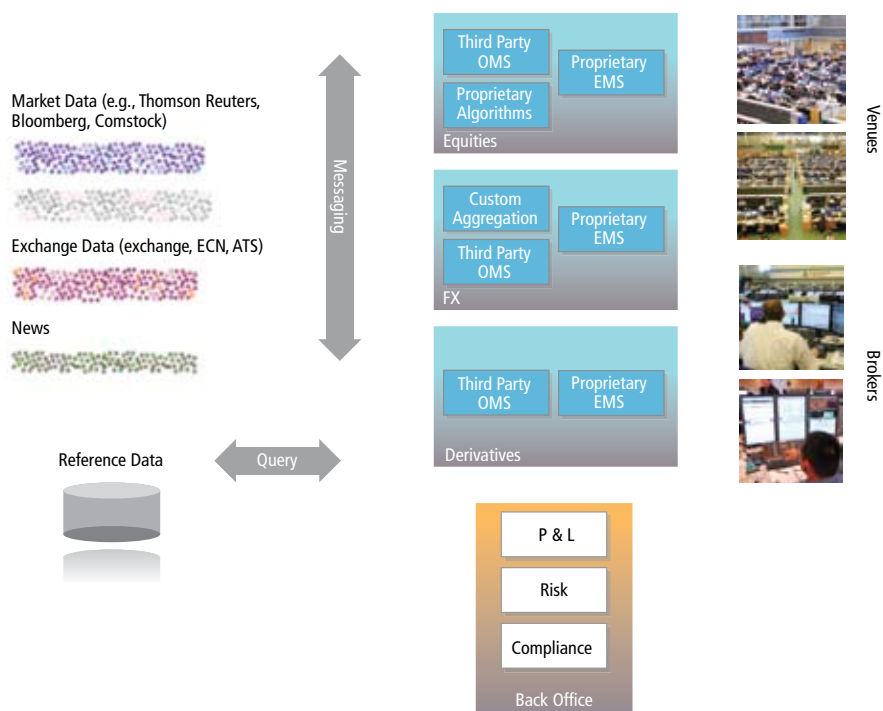
On the output side these filters might trigger intraday alerts and generate analytics and graphical charts to enhance trader or investment manager control. Heads of desk may want to drill down into the detail and understand why the values are changing. Automated compliance auditing algorithms can be run and compliance officers may use this real-time view of trading activity to monitor that regulatory and prudential controls are enforced to satisfy demands for intraday due diligence.

As traders gain confidence, the outputs from the P&L calculation can be fed back to algorithmic trading engines as signals to generate automated orders using investment strategy models. This "closed loop" approach takes automated to a new level of sophistication.

A Case Study

Firms who have deployed Real-Time Profit and Loss still consider it a competitive advantage, so the details of their deployment are treated as trade secrets. Take the case of a large European Hedge Fund with several billion Euros in assets. In 2007 this firm decided to go real-time for its fundamental P&L review.

Their legacy approach of tracking P&L relied on a large number of linked spreadsheets, and only managed a single overnight run per day. In order to respond to the faster moving markets, they decided to update their positions, P&L, risk exposures and mark-to-market valuations on instruments, portfolios, and strategies in step with changing prices. Although the firm does not use high frequency trading strategies, they still wanted to make quick decisions to avoid pricing on different cycles and wasting time and resource on resolving mismatches.

"We faced two choices: one, build Real-Time Profit and Loss from scratch; the other, look for an open platform that provided core processing and connectivity capabilities, and the ability to express our own pricing and P&L rules on top," explained the CTO of the firm. Following a market assessment of suitable software tools, the firm chose the StreamBase CEP platform.

Ease of implementation and maintenance was critical for them, as it is for most hedge funds, whose business is managing investment capital, not software engineering. CEP, for this firm, provides the architectural underpinnings for its Real-Time Profit and Loss system, and the rapid development tools to express the logic that calculates the firm's P&L across systems.

In just a couple of months and with little outside assistance, the team was able to replace a large proportion of their spreadsheets, reducing hours of daily processing down to seconds. They were soon publishing P&L data over their enterprise service bus visible to all their operational platforms and traders. This eliminated unnecessary reconciliations. It also gave traders, portfolio managers and back office staff much more confidence that they now had a single version of the truth, which everyone could share.

The hedge fund had started by recalculating P&L on demand, but moved quickly to updating it on the fly for every tick, valuing all portfolios across currencies and strategies with thousands of instruments and hundreds of books. Now they can quickly assess the impact of changing positions on the overall portfolio moment to moment. The StreamBase capability to access historical market and P&L information allows them to perform root-cause P&L analysis on a tick-by-tick basis simply by changing the data source target from the real-time streams to their in-house tick data store and replaying it through the StreamBase engine with different analyses.

Moreover, the team is finding that the CEP technology is not only reducing operational costs of reconciliation, but is enabling them to increase profit "dramatically" by trading out of poorly performing positions and focusing on more promising instruments and strategies. "Intraday monitoring across all our portfolios allows us to spot trends much more easily," confirmed their CTO. Their current challenge is how to leverage these P&L signals to optimise algorithmic trading strategies.

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The Elements of a CEP-Based Real-Time Profit & Loss Architecture

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The basis for the hedge fund's P&L system is StreamBase, a leading CEP platform and application development studio. StreamBase combines connectivity, algorithms, menus, control screens, and best practices as a solution framework for firms wanting Real-Time Profit and Loss capabilities.

CEP provides an open, "white-box" approach, as compared to the more traditional "black-box," packaged applications. It allows capital markets firms to leverage prefabricated components (e.g., ECN or EMS/OMS connectivity, customizable calculators, etc.) to develop their own high speed, low latency, application fabrics. Encouraged by their customer experience, StreamBase, in particular, now provides Real-Time Profit and Loss application templates as pre-built, customizable software components of their robust CEP platform.

The key elements of such a CEP-based P&L platform include:

■ **Real-Time Profit and Loss Algorithms.** Algorithms that compute Real-Time Profit and Loss against streaming orders and executions — expressed in a CEP language — provide firms with a head-start in obtaining their own customized pricing and signalling algorithms.

■ **Market Data Connectivity.** Built-in connectivity to market data such as Thomson Reuters and Bloomberg accelerates installation and integration with a key source of input to the P&L engine.

■ **OMS and EMS Connectivity.** Trading actions are often signalled by Real-Time Profit and Loss movements, so electronic connectivity between the CEP platform and the firm's EMS and OMS systems can help turn signals into trading action as well as capture trade data.

■ **Middleware and Database Connectivity.** Connectivity to industry-standard relational databases (Oracle, Sybase) provides access to reference data, and allows baseline P&L valuations to be stored and accessed in order to update portfolio-level P&L valuations on the fly. Access to tick data stores, such as from Kx Systems and Vhayu, allows the Real-Time Profit and Loss algorithms to access historical data in real-time.

■ **Visualization Tools.** Real-Time Profit and Loss engines are often integrated with existing graphical user interface frameworks, including Microsoft .NET (WPF), browser-based HTML, Java and other third-party user interface technologies. Visualization templates show a real-time view of the P&L in both tabular and graphical formats with green and red numbers to highlight up or down ticks, and capabilities for drill-down analysis and roll-up summaries by book, portfolio and strategy.

■ **Graphical Application Design Tools.** StreamBase Studio is an example of a CEP development tool designed for both quants and software developers to graphically compose, back-test, deploy, and evolve P&L algorithms. Firms can start with the built-in P&L algorithms and then add algorithms for different currencies, asset classes, roll ups, and netting options. They can change valuation algorithms with multiple rule sets for different trading strategies, and change alert and threshold filters as well. Indeed any of the P&L rules can be amended and maintained by the investment firm.

■ **High-Performance CEP Engine.** A CEP run-time engine, which can be deployed across distributed server grids, provides a powerful execution platform for Real-Time Profit and Loss logic, ensuring a reliable, high-speed, multi-threaded platform for deployment even in the most demanding high-frequency environments.

Market Data
(Reuters, Bloomberg, etc.)

Market Venue
(ECN, ATS, DMA)

Database
(RDBMS)

Reference Data
(Reuters, Bloomberg, etc.)

Adapter Toolkit
(Propriety systems, middleware)

Connectivity

Pricing

P & L

Signaling

Open-Source Algorithms

Fault Tolerance

Management

StreamBase CEP Engine

CEP Platform

StreamBase Studio

Backtesting

Debugging, Profiling

Custom Code
(Java, C++, Pricing Analysis)

Development

Real Time P&L User Interface

Visualization

This open, standards-based platform allows a firm to connect to their portfolio definitions, update them from streaming data from multiple venues, execution flows, and reference data, re-calculate gains and losses on the fly with respect to previously stored baseline valuations, apply multiple threshold filters for signal generation, and output to a range of downstream systems.

Who Needs to Know?

Investment banks, hedge funds, asset managers, and retail brokers can all leverage Real-Time Profit and Loss. Early adopters can reap significant competitive benefits especially in volatile markets.

Investment banks often have to deal with scale - organizational and global scale. Flow traders may focus on transaction cost analysis (TCA) metrics, while market makers and proprietary desks may already have Real-Time Profit and Loss embedded in their trading algorithms. However, the rise of cross asset class and basket trading from asset managers, latency arbitrage from the hedge funds, and best execution regulation for flow traders across fragmented markets can increase the pressure on sell-side firms to consider seriously cross-channel, Real-Time Profit and Loss tools. Where there are options to share liquidity or to internalise a trade and take the risk onto the firm's own books, Real-Time Profit and Loss and what-if scenarios will become essential.

Hedge funds too have been early adopters of Real-Time Profit and Loss for use in high frequency trading strategies that ensure an algorithm's statistical arbitrage comes out in profit. Additionally, as the case study reveals, Real-Time Profit and Loss can also be used as a decision support tool for less quantitative trading styles, giving traders an effective intraday view of their positions.

Asset managers, who traditionally take a longer view and do fewer trades, may be driven more by

concerns around risk and market volatility than increasing alpha. However, growing competition for alpha and the trend towards more cross asset class trading including 130/30 funds, total return funds, liability driven investment, and other hedging strategies may well motivate a more serious consideration of intraday P&L in the asset management space.

Some retail brokers already offer Real-Time Profit and Loss tools as they compete for mind share among the day traders and hands-on high net worth individuals. For them, CEP-enabled Real-Time Profit and Loss offers a more flexible, robust, and rapid alternative to custom software development. The ability to personalize calculations in real-time by extending algorithms enables them to provide more features more quickly than their competitors, and therefore attract and retain more customers and flow.

Moving Forward

Continued Fragmentation and Complexity Drive Innovation and Change

There is a growing recognition that the need to capture and leverage the intellectual property embedded in the trading desk is the new basis for competition in the capital markets. Algorithmic trading, smart order routing, and alternative investment strategies continue to rise in stature. Yet despite some consolidation, it is likely that the capital markets landscape will continue to fragment and become more complex. Volumes and volatility will inevitably grow as the number of e-commerce relationships explodes. As a result, the need to consolidate views across trading platforms, books, portfolios and investment strategies can only increase. This complex environment is complemented by the never-ending series of mergers, acquisitions, spin-offs, and new market initiatives that ensure a steady stream of fragmented systems that will need aggregation.

Flexible services like Real-Time Profit and Loss therefore appear to be an ideal response to these challenges. They help to integrate systems, encourage innovation, and facilitate opportunistic mergers and acquisitions, without major technology consolidation or development programs. In brief, they provide agile yet tight control during turbulent markets.

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About Bob Giffords

Bob Giffords is an independent banking technology analyst based in the UK, who carries out research on the global evolution of the global capital markets. Following a long career in systems development and consulting to the finance sector, he was CTO for a leading bond trading platform in Europe. He is now a frequent speaker at securities industry conferences and writes for various industry journals including The Trade, Waters, Dealing with Technology, Swift Dialogue and Financial World. He can be reached at bob.giffords@btinternet.com.

About Mark Palmer

Mark Palmer is President and Chief Operating Officer at StreamBase Systems, Inc. He leads worldwide sales, marketing and professional services teams. Mark is a long time advocate of the growing role of CEP and has published more than 30 articles on the application of CEP to real world problems and spoken at numerous industry events. In 2005, he won an InfoWorld Innovator award and was named to the InfoWorld Media Group's Innovators Hall of Fame for his work in event processing.

About StreamBase

StreamBase Systems, Inc, a leader in high-performance Complex Event Processing (CEP), provides software for rapidly building systems that analyze and act on real-time streaming data for instantaneous decision-making. StreamBase's Event Processing Platform(tm) combines a rapid application development environment, an ultra low-latency high-throughput event server, and the broadest connectivity to real-time and historical data and leading EMS/ OMS software platforms. Six of the top ten Wall Street investment banks and three of the top five hedge funds use StreamBase to power mission-critical applications to increase revenue, lower costs, and reduce risk. It is also used by government agencies for highly specialized intelligence work. The company is headquartered in Lexington, Massachusetts with European offices in London. For more information, visit www.streambase.com.