



Major U.S. options exchange scales to unprecedented trading volumes with real-time publish-subscribe infrastructure



Scaling from a system that could handle only 300 messages per second in 1997 to one that can handle over 15,000 messages per second today, the Philadelphia Stock Exchange (PHLX) is setting record equity option trading volumes on a monthly basis with the help of Talarian SmartSockets.® To maintain its competitive position, PHLX must scale to even greater levels—to a potential 72,000 messages per second by 2002—without any compromise in real-time performance, reliability or time-to-market.

“With government-mandated initiatives such as decimalization driving quote volumes to astronomical levels, by 2002 we must be prepared to handle a potential 72,000 messages per second in real-time, across increasingly complex and heterogeneous networks—an almost five-fold increase in the message volume we handle today.”

— Douglas Schafer,
PHLX Vice President,
Options Trading
Systems Development

PHLX options trading: fast-paced, huge volumes

The Philadelphia Stock Exchange—the first securities exchange in the U.S. and the nation’s fastest growing sectors index option exchange—trades options on over 800 stocks and indexes which equates to over 50,000 products that must be priced and traded daily. This number continues to increase at a dramatic rate with decimalization driving volumes to historic levels.

Handling more than 10 times the quote volume of U.S. equity exchanges, the PHLX options exchange must receive and process approximately 280 million quotes per day as each option quote reflects a combination of many more variables, such as different strike prices and maturity dates. Each quote must also be updated with every tick of the underlying equity. In addition, PHLX is required to send all options prices generated on its exchange—up to 47 million quotes per day—to the Options Price Reporting Authority (OPRA).

CHALLENGE

Needed: new, mission-critical messaging architecture

In 1997, faced with increased options trading and growing industry requirements, PHLX realized it was quickly outgrowing its “home-grown” Options Trading System—a point-to-point messaging architecture with limited scalability and lengthy development cycles. At the core of PHLX’s most fundamental business activities, this system is responsible for generating, displaying and distributing real-time quotes internally and externally; routing orders to traders’ electronic order books; and executing and reporting trades.

“To effectively compete and capitalize on new opportunities in the future,” said Douglas Schafer, PHLX’s Vice President of Options Trading Systems Development, “we needed to re-architect our system to provide scalable real-time performance, accelerated application development cycles and mission-critical fault tolerance.”



Why PHLX Chose SmartSockets:

- *Unparalleled publish-subscribe messaging architecture*
- *Superior real-time performance*
- *Very high scalability*
- *Reduced application development cycles*
- *Exceptional reliability and fault tolerance*
- *Well-formulated and documented APIs*
- *Ease of software configuration, installation and use*
- *Guaranteed message delivery*
- *Demonstrated commitment to long-term relationship*
- *Architectural consulting for financial applications*
- *Proven experience with mission-critical applications and environments*

SYSTEM REQUIREMENTS

Scalable real-time performance

The PHLX Options Trading Floor moves at a speed few businesses can match, requiring that PHLX's new system be capable of handling high-performance applications that exchange messages in real-time at the same extraordinary speed as the trading floor itself.

Speed and scalability will become even *more* critical as industry initiatives such as decimalization begin driving quote volumes through the roof. Securities regulators mandated a reduction in trading increments beginning in 2000 from fractional sixteenths, or 6.25 cents, to nickel increments and, eventually, to penny increments, fueling higher quote volumes and frequency.

As a result, compared to the 300 messages per second PHLX's system was handling in 1997, industry forecasts predict that by 2002, PHLX will have to handle a potential 72,000 messages per second—an increase of 2,400 percent. PHLX needed a system that could scale to such record-breaking volumes without any compromise in real-time performance or application development time.

Mission-critical reliability

Nothing is more essential in the high-stakes world of financial options trading than system reliability, where the direct and indirect costs of downtime are enormous. If the PHLX Options Trading System experiences a significant failure that impacts trading and quoting for longer than 15 minutes, notice to the Securities and Exchange Commission (SEC) is required.

“With industry message volume continuing to explode and communication networks becoming faster and more efficient,” said William Morgan, PHLX's Senior Vice President and CIO of Financial Automation,

“it is absolutely critical that our interprocess communications be stable, fast and efficient.”

Seamless message routing over mixed network topologies

Leveraging its current IT investments, PHLX needed a solution that could co-exist with its existing n-tier, client/server-based architecture, yet expand to include new platforms in the future. The system had to be capable of seamlessly routing messages over PHLX's complex mix of heterogeneous hardware and software platforms.

Within the PHLX options trading environment, these platforms include: Sun systems running Solaris; Windows NT-based PCs and Network Computers (NCs) used to calculate and distribute option quotes, orders and trades; and fault-tolerant Stratus servers running Stratus VOS used to process transactions.

Guaranteed Message Delivery (GMD)

Another key requirement for PHLX was ensuring that if its Options Trading System went down for any reason, the option orders and trades would be automatically recovered and delivered to the receiving application when the system was brought back up.

PHLX also needed to provide traders with confirmation not only that their message (e.g., order or trade) was *delivered*, but that their message was delivered to the right place and *completely processed* by the application.

Long-term relationship

Finally, understanding that it was choosing a long-term strategic partner, PHLX searched not only for a vendor with a technically superior messaging infrastructure product, but also for a partner that was willing to establish a long-term relationship with PHLX and help it achieve its business goals for many years to come.

SOLUTION

Hands-down winner:

Talarian SmartSockets

After an exhaustive evaluation of messaging infrastructure alternatives, PHLX chose Talarian SmartSockets as the infrastructure on which to build its next-generation Options Trading System. They began a phased implementation in mid 1997 with initial deployment in late 1997.

A complete publish-subscribe middleware solution, SmartSockets provides the industry's richest application programming interfaces (APIs) and class libraries, enabling the development of real-time, highly-distributed applications faster than any other middleware product.

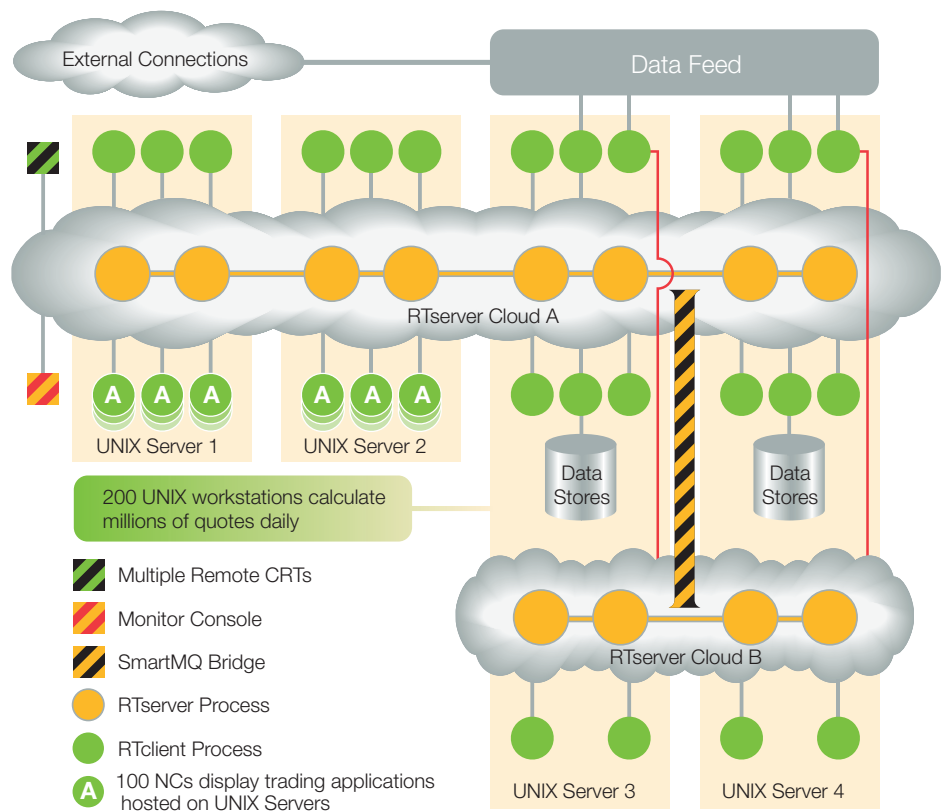
"When every second counts," said Morgan, "we employ only the technology that optimizes our business in a real-time network computing environment. SmartSockets provides a more open and far more advanced publish-subscribe technology for the high-performance and scalability we require as the trading volume on our options trading floor increases."

Today, PHLX has fully deployed SmartSockets across its entire options trading floor, successfully achieving its goal of full architectural deployment in three years and bringing measurable results.

RESULTS

Development cycles reduced by 20 to 30 percent

With SmartSockets taking care of network interfaces, guaranteeing message delivery, handling communication protocols and dealing with recovery after system/network problems—a lot of things PHLX used to have to do manually—PHLX has reduced its application development cycles by 20 to 30 percent, greatly speeding its time-to-market. Senior IT staff have also been able to focus on



PHLX Options Trading Systems Architecture

Built on Talarian's SmartSockets publish-subscribe infrastructure, PHLX's system consists of two Talarian RTserver™ clouds running across four UNIX server class machines. Hundreds of client processes (e.g., primary and backup loggers, quote handlers, guardians, data brokers and trader applications) run locally on the UNIX servers. Hundreds of remote applications (e.g., quote calculators) run on UNIX workstations. Bridging of data between the two RTserver clouds, including guaranteed message delivery, is accomplished via a Talarian SmartMQ™ message queuing bridge.

higher-level application requirements.

For example, using SmartSockets' publish-subscribe paradigm, PHLX rapidly developed a trading floor application called "X.Station" that allows traders to trade orders electronically on the floor, eliminating paper-based transactions and improving the speed at which transactions can be handled.

Increased scalability

Today, the PHLX options exchange uses SmartSockets to deliver up to 15,000 quotes per second to floor traders, setting record equity option trading volumes each month.

"Before SmartSockets, a lot of our development time was swallowed up by infrastructure design issues. Now, freed from the complexities of the underlying network infrastructure, we can concentrate on designing and delivering high quality and reliable applications that can give our end users an edge."

—Douglas Schafer, PHLX

Best of all, PHLX can scale to handle extraordinary message volumes simply by making configuration changes—easily adding more clients, servers and applications to its Options Trading System—without having to rewrite code.

“The critical nature of orders and trades on our network demands a middleware that allows us to easily move data around the various applications,” said Schafer. “Talarian’s real-time publish-subscribe infrastructure allows us to increase the number of orders and trades without having to change the applications on the system to accommodate the growth. Additionally, there’s no margin for error—SmartSockets’ hot failover feature ensures messages are automatically rerouted if the server fails.”

SmartSockets’ scalable architecture uses many of the same techniques that have made the Internet scalable, including a hierarchical namespace, dynamic routing of messages and recovery from transient network failures.

Enhanced reliability of IPC mechanisms

SmartSockets’ dynamic load balancing capabilities enable PHLX to balance the flow of information between all receiving processes, handling the majority of PHLX system failures and resulting in graceful degradation.

“Whereas we used to have to develop point-to-point interfaces and specialized fall-back scenarios for those interfaces,” said Schafer, “now we simply publish into the

SmartSockets cloud. With features such as built-in load balancing and failover handling, the information is quickly and reliably delivered.”

In addition, PHLX is fully exploiting SmartSockets’ GMD capability to guarantee delivery and processing of option orders and trades. “Every single PHLX option order and trade now goes through the SmartSockets system,” said Schafer.

LOOKING AHEAD

Expanding SmartSockets

Pleased with the results SmartSockets has brought to its Options Trading Floor, PHLX is actively pursuing the expansion of SmartSockets into other parts of the Exchange.

“Without SmartSockets, we wouldn’t be where we are today,” said Schafer. “Implementing it as part of our new architectural paradigm has proven to be the cornerstone of our success. We have no doubt SmartSockets will continue to play a critical role in helping us grow our systems and infrastructure to meet new demands and requirements as the financial trading world continues to evolve.”



“SmartSockets’ tremendous scalability has helped the PHLX achieve record trading volumes. In July 2000, for example, our equity options volume exceeded five million contracts traded, a 57 percent increase over the volume in July 1999.”

— Douglas Schafer, PHLX

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