

# Direct Edge Switches to Ultra Messaging, Improves Performance with Less Hardware

CASE STUDY



This document contains Confidential, Proprietary and Trade Secret Information (“Confidential Information”) of Informatica Corporation and may not be copied, distributed, duplicated, or otherwise reproduced in any manner without the prior written consent of Informatica.

While every attempt has been made to ensure that the information in this document is accurate and complete, some typographical errors or technical inaccuracies may exist. Informatica does not accept responsibility for any kind of loss resulting from the use of information contained in this document. The information contained in this document is subject to change without notice.

The incorporation of the product attributes discussed in these materials into any release or upgrade of any Informatica software product—as well as the timing of any such release or upgrade—is at the sole discretion of Informatica.

Protected by one or more of the following U.S. Patents: 6,032,158; 5,794,246; 6,014,670; 6,339,775; 6,044,374; 6,208,990; 6,208,990; 6,850,947; 6,895,471; or by the following pending U.S. Patents: 09/644,280; 10/966,046; 10/727,700.

This edition published June 2011

## Table of Contents

Original ISE-SX Architecture Resisted Growth . . . . .	2
The Next Generation Exchange with Informatica . . . . .	4
Secrets of Informatica Ultra Messaging® Performance . . . . .	6
Direct Edge and ISE-SX Architectures Unfurl with UMP Flexibility. . . . .	7
UMP Resiliency Strengthens All Direct Edge Systems . . . . .	8
Direct Edge Quickens Step with Smaller System Footprint. . . . .	8
Conclusion. . . . .	8
About Direct Edge . . . . .	9
About Informatica Ultra Messaging. . . . .	9

After a highly successful move from an ATS business model to a financial exchange business model, Direct Edge realized it had to prepare for growth in trading volume across all its exchanges. In the acquisition of International Securities Exchange Stock Exchange (ISE-SX) in December of 2008, Direct Edge discovered the innovations needed to build their next generation exchange infrastructure. In June of 2008, ISE-SX had transformed its technology infrastructure using the next generation messaging products of Informatica, formerly 29West, Inc. The result was a dramatic increase in capacity, reduced latencies in both average and high volume periods, a smaller system footprint and the flexibility to respond to future changes in regulatory and business requirements. This white paper provides an overview of the execution architecture and benefits to ISE-SX of Informatica's Ultra Messaging® family of products that Direct Edge has begun to implement across all its exchanges.

## Original ISE-SX Architecture Resisted Growth

With increasing latency, throughput, availability, and regulatory demands on execution venues, the right architecture is essential to continued competitive advantage in the coming decade. ISE-SX was growing fast in both customers and volume. During a capacity planning review of their IT infrastructure, they concluded that they would require a 100% increase in their messaging hardware investment by the end of 2008. And since the hardware included high availability servers and SAN disks, such an expansion would be very expensive.

The ISE-SX system consisted of customer gateways which processed incoming orders and sent them to the messaging brokers. The messaging brokers wrote the orders to solid state disks for persistence, and then fanned out the orders to the appropriate primary and backup matching engines for order execution. Orders for securities were split by alpha range over matching engines. Orders for "A" securities go to a different matching engine than orders for "H" securities.

Orders from the gateways through the messaging brokers to the matching engines used TCP exclusively. The message path between the gateways and the messaging brokers consisted of a significant mesh of point-to-point connections. In parallel with this application flow, National Market System (NMS) market data was sent to the message brokers and then to the matching engines for order execution.

After execution, the matching engines published the executed order fills back through the messaging brokers to the customer gateways for delivery to ISE-SX trading parties, along with market data updates to subscribed market participants. Fills were sent over the same TCP mesh. Fills were also sent via a second set of message brokers using TCP to the back-end compliance systems for additional processing.

The main weaknesses of ISE's previous messaging system were

1. High average latency
2. High latency distributions
3. Low throughput
4. Limited to only TCP transport

If ISE decided to buy and install all the expensive new hardware needed to increase their capacity, they would still be using their old messaging software, with its high latencies and multiple-API complexity. Moreover, additional software licenses would be needed. In addition, they would still be limited to a cold failover method for high availability, instead of a much more robust hot or warm failover approach.

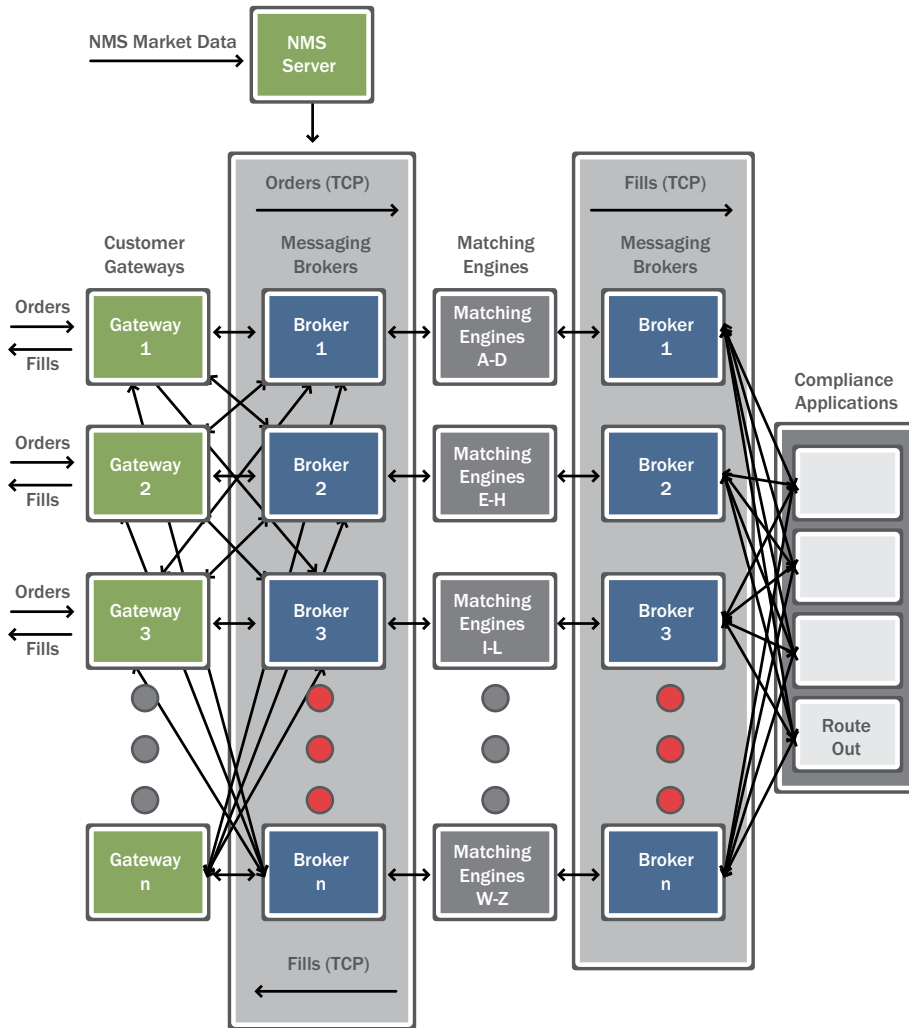


Figure 1: Previous ISE-SX Exchange System

“The flexibility to use TCP and Reliable Multicast, with the option of streaming and persistence, in different portions of the overall architecture, allowed us to implement key elements to achieve low latency processing of order flow system-wide, even during times of high volume volatile trading. Furthermore, UMP’s feature breadth under a single API has allowed us to rapidly deploy new capabilities in response to changing business and regulatory requirements.”

John Ryan  
Chief Architect, Direct Edge

Clearly ISE’s current system would be difficult and expensive to scale to their growing business. Therefore, to address the capacity, latency and resiliency issues, they set out to find messaging solutions that would meet four goals:

- Sustain a much higher rate of growth in customers, markets, and volume
- Lower latency throughout their system
- Lower cost and reduced system footprint
- Increased system stability and availability

## The Next Generation Exchange with Informatica

ISE-SX deployed Informatica’s Ultra Messaging® Persistence Edition (UMP), creating a messaging backbone that allows pub/sub-based communication between applications spanning the front end order gateways, the matching engines and the back end compliance systems. The removal of brokers and daemons offers the most efficient path of communication for disparate applications and also provides increased overall system resiliency by eliminating message flow components susceptible to failure.

As illustrated in Figure 2, orders still arrive via the customer gateways from ISE’s trading counterparties. The customer gateways terminate the FIX connections and after processing the incoming orders, publish them on the Informatica UMP backbone. The UMP backbone delivers the orders to a sequencer for system-wide sequencing before delivery to the exchange’s matching engines. All input to the Matching Engines still uses TCP. Once orders have been executed, the matching engines use reliable multicast to perform the following.

- Publish filled or booked orders along with market data updates to the customer gateways
- Persist the filled/booked orders in parallel with delivery to the customer gateways
- Publish the filled/booked orders to the back end compliance systems.

ISE-SX replaced their broker-based messaging solution with the Informatica Ultra Messaging architecture described above in June of 2008. Figure 3 illustrates the resulting dramatic reduction in both average and 75th percentile latencies and increases in exchange capacity during volatile market periods.

In Figure 3, the blue line is the 75th percentile latency and the pink line is the average system latency. Notice the dramatic drop in both values around June 2008 when ISE-SX implemented Informatica’s UMP. Perhaps more important, during the market turmoil of September, October and November of 2008, ISE-SX processed 5 to 6 times more transactions with only a slight up-tick in average and 75th percentile latencies.

These results speak to the power and efficiency of Informatica’s nothing-in-the-middle design of UMP. The following sections provide details of how UMP accomplished such a dramatic improvement in addition to other benefits of Ultra Messaging from Informatica.

- Secrets of Informatica Ultra Messaging Performance
- Direct Edge and ISE-SX Architectures Unfurl with UMP Flexibility
- Direct Edge Quickens Step with Smaller System Footprint

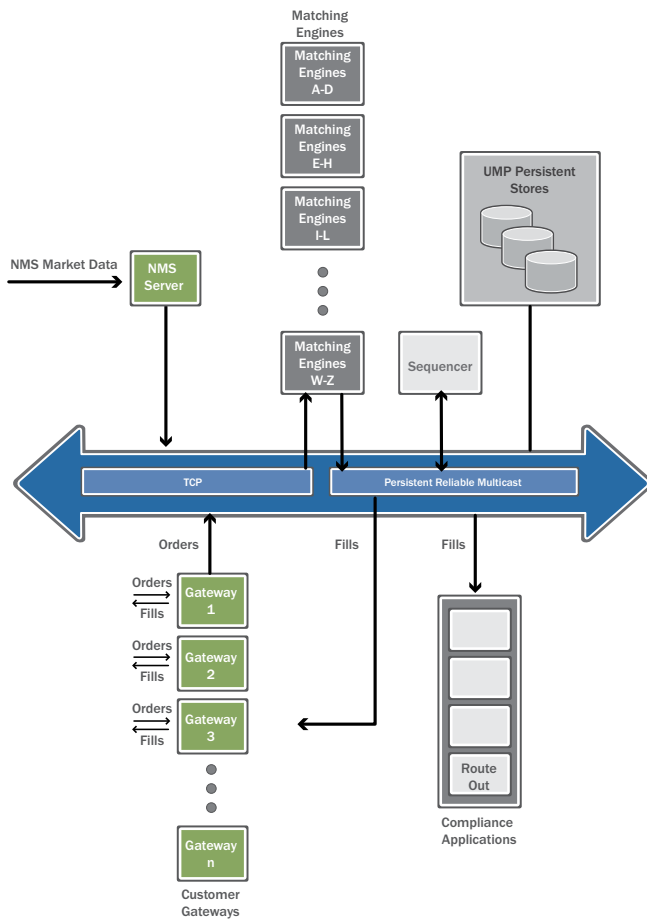


Figure 2: ISE-SX Exchange with Informatica

“We have implemented UMP’s hot-hot failover capability within key components to ensure high availability of the system,”

John Ryan  
Chief Architect, Direct Edge

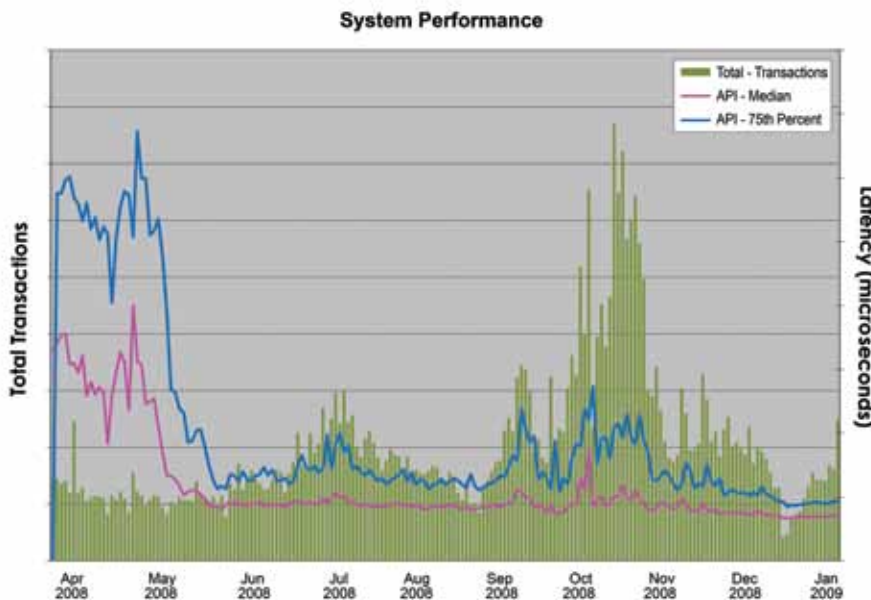


Figure 3: ISE-SX Performance with Informatica’s UMP

As a result of the architectural change enabled by Ultra Messaging, Direct Edge’s systems were able to maintain huge latency improvements even while experiencing record market volumes.

“Having looked at a number of messaging technologies, both hardware and software, Informatica, using commodity hardware, consistently outperformed the others without the need for proprietary, restrictive, and unproven hardware appliances.”

John Ryan  
Chief Architect, Direct Edge

## Secrets of Informatica Ultra Messaging® Performance

The design philosophy of Informatica’s Ultra Messaging Persistence Edition (UMP) product can best be described as nothing-in-the-middle or direct application-to-application communication. By removing unnecessary daemons and servers from the message flow, UMP offers unparalleled low latency and throughput for streaming, persistence, and queued messaging within trading systems. UMP’s concept of Parallel Persistence®, shown in Figure 4 allows message delivery unhindered by the persistent storage of messages. Informatica developed Parallel Persistence to provide consistent quality of service during system recovery, while not impacting performance during normal operation.

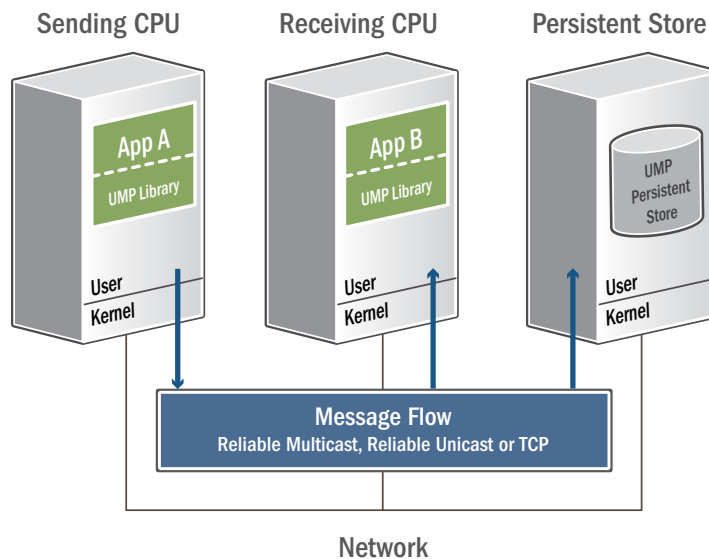


Figure 4: ISE-SX Exchange with Informatica

Without message brokers in between, applications can act as publisher, subscriber or both. Using the same UMP API, Direct Edge/ISE-SX developers easily publish orders from customer gateways over TCP and subscribe to filled orders using reliable multicast. UMP uses the underlying network to transport message data instead of a message broker resting on a server with its own system latencies to inhibit speed and capacity.

Likewise, Direct Edge/ISE-SX matching engine applications use the same UMP API to subscribe to both NMS market data and to customer orders over TCP. After order execution, matching engine applications publish the filled orders to both the customer gateways and compliance applications using the efficiency of reliable multicast without any need for message brokers.

Informatica’s UMP offers guaranteed in-order delivery to the publication of filled orders. The placement of the UMP Persistent Store in a path parallel to the message path not only enhances throughput and lowers latency, but also allows multiple Persistent Stores to support hot-hot failover. See UMP Resiliency, page 8, for more.

## Direct Edge and ISE-SX Architectures Unfurl with UMP Flexibility

Before Informatica's UMP was available, Direct Edge and ISE-SX system architects had basically three options:

1. Limit themselves to messaging products with very few features, thus forcing the development of non-optimal designs
2. Use multiple messaging products with different APIs to meet the specific needs for portions of the design, substantially increasing overall system complexity and cost.
3. Invest in an in-house developed messaging solution

With the flexibility of Informatica's UMP, system architects and developers now have the ability to design the right systems using an optimal combination of network transports, qualities of service, and messaging semantics over a single API.

Flexibility is inherent in the full range of Informatica Ultra Messaging offerings.

- Streaming Messaging: Ultra low-latency, streaming, pub/sub messaging
- Persistent Messaging: Guaranteed in-order delivery of different classes of messages at unprecedented low latencies
- Queued Messaging: Source decoupled from the receiver, allowing once-and-once-only message delivery and automatic load-balancing across application sets
- Local (Shared-Memory) Messaging: Local inter-process communication through a powerful pub/sub messaging API that takes advantage of the rapid advances in multi-core CPU design
- Desktop Distribution: Messaging systems designed with the desktop receiver in mind, with optimized transport choices and delivery models
- TCP Fan-Out: TCP-based messaging system handles delivery in all cases using the same powerful API
- Caching and Replay: High-speed, real-time caching and replay of all live data, historical data, or any subset thereof along with the ability to receive market snapshots during the trading day
- LAN/WAN Bridging: Full multi-hop forwarding, LAN/WAN traversal, firewall bridging, enabling ultimate control over a world-wide next-generation messaging platform
- Failover: Zero-latency failover, hot-warm failover options, and guarantees that performance of well-behaving system components are unaffected in the event of the failure of another component. The ability to spread fault-tolerant components across multiple sites for reduced operational risk.
- Monitoring: Complete statistics of every aspect of the underlying messaging system. Application-level information, as well as centrally-available statistics, allowing real-time performance information.

## UMP Resiliency Strengthens All Direct Edge Systems

In addition to the latency and throughput benefits of Informatica's nothing-in-the-middle design, UMP also offered substantially increased system resiliency. The removal of their legacy message brokers provides both ISE-SX and Direct Edge two important benefits.

1. Reduces the number of components within the message flow that can fail.
2. Allows any Direct Edge application to run in a hot-hot configuration with the ability to publish in parallel to UMP Persistent Stores.

UMP's hot failover ability provides zero-latency failover for any component in the message path from source to receiver with no additional programming. Direct Edge publishing applications all have a redundant application. Both applications send the same message using UMP hot failover API calls. UMP ensures that subscribing applications receive only one copy of the message. As a result, subscribers don't even care if a publisher has failed and experience no latency spike or delay waiting for a cold or warm failover.

Also, by decoupling the persistence function from the delivery of data, Informatica's Parallel Persistence also affords efficient system recovery for down applications without impacting live data. For example, if UMP fails over to a backup persistent store, no interruption in message delivery occurs. This holds true for all UMP resiliency strategies; failed components do not hinder the performance of well-behaving system components.

## Direct Edge Quickens Step with Smaller System Footprint

The dramatic gains in throughput and latency realized by ISE-SX came on commodity hardware. This significant cost benefit was not lost on Direct Edge, which is in the process of extending the savings and efficiencies of Informatica's Ultra Messaging to all of its exchanges.

- UMP reduces the overall system footprint – both hardware and software – in the following ways.
- UMP's reliance on underlying network hardware for replication, forwarding and filtering instead of message brokers reduces the server footprint by sharing the processing burden between servers and their underlying network.
- Parallel Persistence failover protocols, quorum/consensus and round robin remove the need for costly storage area networks.
- The removal of message brokers reduces the total number of software processes that need to be managed as well as the cost of licenses for the daemons/brokers.

When ISE-SX implemented UMP, it reduced its system footprint by over 50% with the removal of messaging servers, broker software licenses and storage area networks for persistence. This could be considered a 10-times increase in capacity, since ISE-SX was able to process 5 times the number of transactions on half the hardware and software. Direct Edge is taking the same path in its ongoing, enterprise-wide upgrade.

## Conclusion

In acquiring International Securities Exchange (ISE), Direct Edge also acquired the next generation exchange infrastructure based on the Informatica Ultra Messaging family of products. By choosing UMP as its enterprise messaging solution with its low latencies, high throughput, consistent quality of service, and wide feature set, Direct Edge will be able to add capacity to all their exchange systems, implement all the key elements of their architectures, add hot-hot failover for any system components, all while avoiding a large investment in hardware infrastructure.

## About Direct Edge

Direct Edge is an electronic stock market. It is the third largest U.S. equities marketplace, behind only the NYSE and NASDAQ. Based in Jersey City, Direct Edge has 80 employees and is in the process of converting from electronic communications network (“ECN”) to a licensed stock exchange. Direct Edge is the fastest growing stock market, raising its market share from just under 5% in October 2008 to nearly 13% in August 2009. (For comparison, NASDAQ is just over 20% and the NYSE 27%.)

Direct Edge offers the next generation of displayed markets. With U.S. cash equities volume routinely exceeding 1.5 billion shares per day, Direct Edge uses multiple ECN and exchange platforms and unique order types to match complementary forms of liquidity based on sensitivity to transaction cost, fill rate, and fill speed, while maintaining high execution quality and low latencies. Direct Edge is owned by a consortium that includes the International Securities Exchange, Knight Capital Group, Inc., Citadel Derivatives Group, The Goldman Sachs Group, and J.P. Morgan.

## About Informatica Ultra Messaging

Informatica Ultra Messaging provides up to a 10-times latency reduction and 100-times throughput improvement over traditional messaging designs across a wide range of use cases, including streaming, persistence, caching, queuing and desktop distribution. Informatica provides customers with the highest-performing, most tunable, most controllable, most powerful messaging API in the industry, with full end-to-end monitoring capabilities. Many banks, hedge funds and exchanges have ported their applications to the Informatica Ultra Messaging framework, and are attesting to dramatic performance improvements as well as greater network stability when driving unusually high data loads. Powering over 140 missioncritical production deployments worldwide, Informatica’s Ultra Messaging is the clear leader.

## Learn More

To request a Free Software Evaluation, please visit [www.informatica.com](http://www.informatica.com) and click the Contact Me button. If you would like to be added to our mailing list or receive copies of our networking and messaging white papers, please e-mail us at [UMInfo@informatica.com](mailto:UMInfo@informatica.com).

## About Informatica

Informatica Corporation (NASDAQ: INFA) is the world's number one independent leader in data integration software. The Informatica Platform provides organizations with a comprehensive, unified, open, and economical approach to lower IT costs and gain competitive advantage from their information assets. Nearly 4,000 enterprises worldwide rely on Informatica to access, integrate, and trust their information assets held in the traditional enterprise and in the Internet cloud. Visit [www.informatica.com](http://www.informatica.com).



Worldwide Headquarters, 100 Cardinal Way, Redwood City, CA 94063, USA  
phone: 650.385.5000 fax: 650.385.5500 toll-free in the US: 1.800.653.3871 [www.informatica.com](http://www.informatica.com)