TradeTest Financial Market Simulation and Testing Solution

The latest market data and fast, accurate trade execution are the life's blood of today's financial markets. Technological advances can translate into a killer competitive advantage — but the slightest system errors can cause million-dollar losses.

How do you know your system is getting the best prices for your clients? Is your application in compliance with the latest specifications? The answer is simple – you test.

Unique in today's market, TradeTest™ is the only automated QA solution capable of emulating the entire North American equities market in the test lab environment. Delivering functional testing with a level of realism that can only be described as an industry breakthrough, TradeTest offers a dynamic solution for evaluating the performance of virtually any trading or order handling system.

Capitalizing on Business Advantages Delivered by Enhanced Systems Testing.

As technology evolves, the first company to offer new services and order types will attract the lion's share of the business. TradeTest gives you the power to produce quality-tested software at a rate that lets you take the lead in developing and deploying new trading technologies. Imagine cutting application testing from weeks to days — and leveraging sophisticated automation that empowers you to run complex regression suites against new apps at the click of a mouse.

This turbocharged approach frees your best testing personnel to focus on developing any type or quantity of new tests, whether highly complex, negative, session, functional, timing, etc., instead of simply rehashing old ones. Testing of known factors becomes routine, new tests are easily introduced, and the chances of errors slipping through becomes negligible.

Key Benefits

- Provides highly realistic simulations of all market data feeds and system interconnections encountered by Exchange Trading, Member Firm, Market Maker, or Order Handling systems operating in North America
- Dramatically reduces development and testing time for new software applications, delivering competitive advantages by reducing time-to-market and increasing product quality
- Reduces support costs and increases customer satisfaction by continually increasing testing scope and precision for all applications
- Delivers enhanced testing flexibility through management of expected results:
  – Generation of result set comparisons for regression testing
  – Outcome can be manually altered as requirements change
- Provides interface simulators for SIAC (CTS, CQS, and ITS), NASDAQ (NMS, UTP, CTCI, SDP, and QIX), and other consolidated market data providers
- Supports concurrent use by multiple testing professionals, whether working cooperatively or needing complete isolation
- Offers a common test repository that can be accessed by on-shore or off-shore authorized users
- Open architecture streamlines development of new testing interfaces, facilitating rapid and successful deployment of new products and services
- Reporting capabilities are designed to make key data readily accessible to internal auditors or the SEC
- Simulation support for all North American Market Data protocols (broadcast and point-to-point), including timely, versioned updates for all announced protocol changes
- Test cases are developed in plain English, not in a programming language

Unprecedented realism in equities market testing.

Until now, testing in the equities markets has relied on one-dimensional solutions. Traditional testing approaches are based on simple market data replays from NYSE or NASDAQ trading days, and simulated requests from groups of clients sending transaction orders and executions. Legacy testing systems of this type are not capable of interacting with one another, and only provide basic testing capabilities.

In marked contrast, TradeTest offers a multidimensional solution for testing and analysis of all component systems in equities trading applications. TradeTest is a unique solution capable of emulating the entire North American securities market, with full synchronization of data across traders/brokers, exchanges, order routers, ECNs, and market data feeds.

In TradeTest simulations, the market moves as a single, consistent entity. Trades made by the TradeTest simulators actually affect the price of securities that are being streamed across the TradeTest system—a breakthrough improvement over 'replay' tests. Prices are updated in real time, with each component of the market interacting with all

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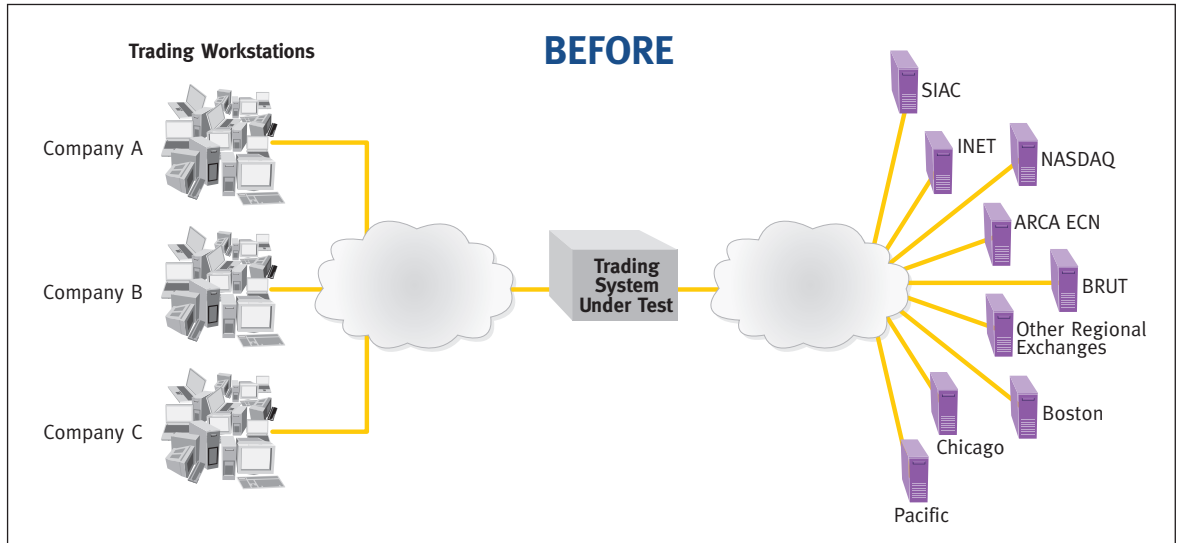+852-2166-8382
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Analyze | *Assure* | *Accelerate*™

Trading Workstations

BEFORE

Company A

Company B

Company C

Trading System Under Test

SIAC

INET

NASDAQ

ARCA ECN

BRUT

Other Regional Exchanges

Boston

Chicago

Pacific

Until now, analyzing performance of the corporate trading system has been restricted to after-hours testing, weekend testing, forced industry-wide tests, or functional testing with non-interactive data.

others exactly as it does during the actual trading day.

The TradeTest software application is installed as a client/server solution in the test lab environment, providing a shared resource that can be accessed by multiple developers and testers using the TradeTest Tester Workstation. Developers and Quality Assurance testers access test suites that are stored in the centralized Script Repository, and can quickly develop new tests to respond to emerging changes in the marketplace. When a test is ready to be initiated, messages are sent from the Tester Workstations to the TradeTest Control Manager (TCM), and the appropriate simulators are activated.

A highly flexible solution, TradeTest enables test engineers to use only the market simulators needed to conduct a specific test. This modular approach is designed to serve a wide range of businesses and use cases, including broker/dealers, market makers, ECNs, market data providers, and securities exchanges. Testers are able to focus on any specific component of the market, or any combination of market players and simulators. The actual system under test is analyzed as the primary component of the test, seamlessly interacting with simulators that accurately represent the behavior of the rest of the market.

TradeTest Control Manager (TCM)

The main event coordinator of the TradeTest solution, TradeTest Control Manager is directly connected to all Tester stations and all simulators for each "target" test system. During the test execution phase, TCM implements test execution requests from client Tester Workstations by sending timing, ordered routing, and test case transaction messages to the appropriate simulators for the chosen target. TCM also captures returned responses and stores these test results in the TradeTest Script Repository for every test case executed.

This event-driven architecture provides a reliable and repeatable method of running regression tests, providing a consistent baseline and highlighting variances as they deviate from the expected norms. After the requested test case sequence has been executed, a detailed pass/fail report is generated. This report compares the actual results received with the expected results stored in the Script Repository, delivering critical performance insights into the system under test.
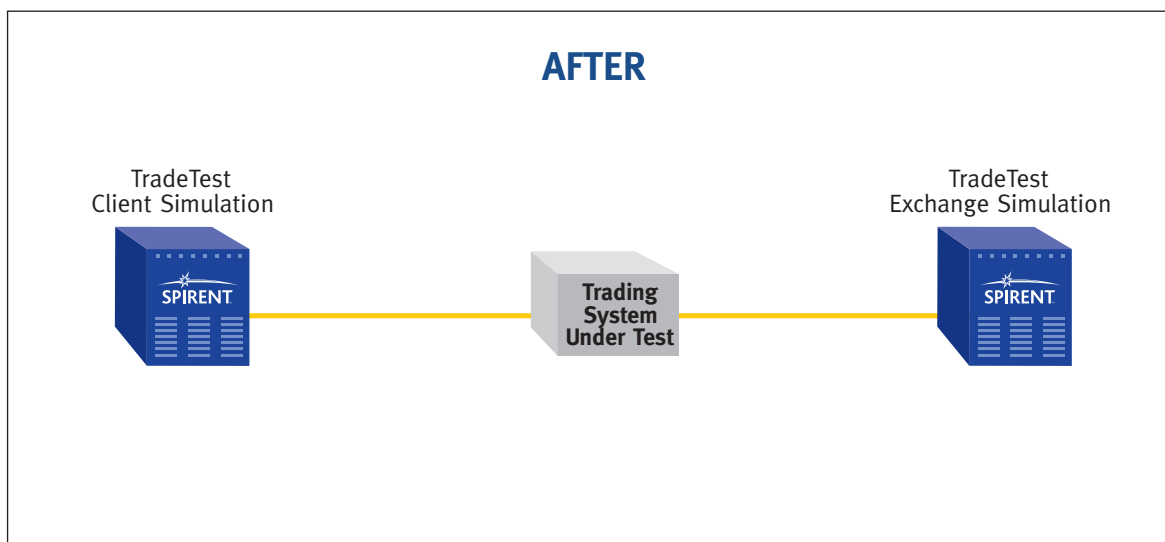
Automation

TradeTest's automation capabilities allow hundreds or thousands of test cases to be managed, automated, and initiated at the click of a mouse, delivering a quantifiable and repeatable testing solution. New test cases can be quickly added to established test suites, enabling QA test developers to release application test suites in record time. This modular testing approach enables financial institutions to respond quickly to evolutions in the marketplace, such as formal requirements changes or the introduction of new technologies.

Time-to-market for new products can be dramatically reduced, leading to possible gains in market share. Competitive advantages can also be realized by providing customers with new features and order types — which can be deployed with confidence after they have been rigorously tested to ensure transparency with every imaginable protocol, standard, or custom.

Customizable Reporting

TradeTest Crystal™ report generation delivers the capability to generate reports against any Script Repository. Standard, management, and analytical report templates are included, and are easily customized to meet the precise needs of a wide variety of financial entities. This streamlines the process of report generation, and puts key analytical data into a format that is readily accessible by internal

AFTER

TradeTest
Client Simulation

Trading
System
Under Test

TradeTest
Exchange Simulation

Lab-based analysis of the system under test enables suites of regression tests to be conducted, ensuring optimum performance in production networks.

auditors as well as the Securities and Exchange Commission (SEC).

The sophisticated range of reporting capabilities are ideal for most financial entities. Whether your organization needs to generate overview reports, coverage reports for documentation of test case analyses, trend reports, analytical reports, or highly customized reports, TradeTest Crystal reporting capabilities are ready to meet the challenge.

Spirent Global Services

Testing and deploying mission-critical technologies is a tough challenge. In a competitive industry where time-to-market is reflected on the bottom line, support from Spirent Global Services can make the difference between simply treading water and increasing your market share. By leveraging Spirent's expertise in devising and implementing testing methodologies, your organization is free to focus on its core business objectives.

Our experienced engineers enable your business to implement proven testing solutions, leveraging expert Spirent resources in addition to those that already exist in-house. Currently assisting a wide range of financial entities, Spirent Global Services has the expertise that can help your business become a market leader.

- TradeTest Implementation Service provides a turnkey solution for deploying your new TradeTest solution. The comprehensive program manages all facets of installing and integrating TradeTest into your test bed. Our experts ensure that your solution is properly configured and provide hands-on training for your staff.
- TradeTest Engineering Service reduces risk and accelerates delivery of custom functionality by giving you access to TradeTest product experts from Spirent Global Services. Spirent's team of software consultants conducts a full needs assess-

ment and requirements definition to deliver a fine-tuned solution. Our consulting resources work independently of release cycles, which enables quick ramp-up, development, testing, and deployment of new or customized solutions.

Simulators

TradeTest supports the industry-standard FIX and CMS protocols for order entry. It also provides interface simulators for SIAC (CTS, CQS, and ITS), NASDAQ (NMS, UTP, CTCI, SDP, and QIX), and many other consolidated market data providers. Capable of generating orders for entry into any trading system, TradeTest is highly extensible and can be easily upgraded to include any relevant market-data feeds.

The workhorses of the TradeTest system, the simulators are small-footprint C++-based server processes that are coordinated by the TCM. All simulator messages, record types, and applicable field data are template-driven. Customized messages, record types, and field data values can be added by editing the templates, and stored in the database tables of the Script Repository.

FIX Client Simulator

Handles all FIX protocol transactions for order entry. Capable of handling all FIX protocol transactions for order entry/replay; simulates one or more clients into the trading system or exchange. Used for functional regression and stress testing, TradeTest supports industry-standard FIX versions 4.0 - 4.4, any custom versions of FIX, and ARCA-FIX, NYSE-FIX, INET-FIX, BRUT-FIX, NASDAQ-FIX, etc.

FIX ROUTE (Server-Side Simulation)

General server-side interface and trading engine simulator supporting full industry-standard FIX versions 4.0 - 4.4, including any custom versions of FIX. Primarily used for generic FIX regression and route testing, multiple FIX route destination simulators may

be configured as distinct market centers or other trading destinations to provide support for complex route testing scenarios.

CMS Client Simulator

Primarily used for regression and route testing, this service is a general server-side interface and trade simulation supporting common CMS Services. Capable of handling the latest FCS/FIX protocol transactions for use on CMS, supporting ADOT and SDOT, Drop Copy, and BBSS services.

SIAC Simulator

Full-service implementation includes CQS/CTS IP multicast, ITS, and services for special requirements.

- CQS/CTS Multicast Services facilitate the reporting of quotes and trades for testing exchange systems. Using this simulator, clients can include Listed Market Data (quotes or trades) along with any transaction to create the required market conditions for a functional test case
- CQS/CTS Participant Services facilitate the reporting of quotes and trades by exchange participants for testing with TradeTest
- ITS Trading Services facilitates simulation of ITS away-market commitments routed to the exchange participant (target test system) for purposes of functional and stress testing. This integrated service supports the full ITS specification, and provides full simulation of integrated market environments (CQS and CTS) to allow realistic route testing to away-market participants
- Options Price Reporting Authority (OPRA) simulates quote and trade data for the American Stock Exchange, Chicago Board Options Exchange (CBOE), International Securities Exchange, Pacific Exchange, and Philadelphia Stock Exchange

NASDAQ Simulator

Includes NASDAQ Multicast Services, UTP Quote and Trade Participant Services, CTCI Trading Services, as well as SDP Simulation, QIX Quote and Trade Services.

- NASDAQ Multicast Services include: NQDS, UQDF^{SM}-UTDF^{SM}, OMDF^{SM}, TotalView^{SM}, OpenView^{SM}, TDDS^{SM}, NIDS^{SM}, BBDS^{SM}, and MFDS^{SM}
- UTP Quote and Trade Participant Services facilitate the reporting of quotes and trades by exchange participants for testing with TradeTest
- CTCI Trading Services simulates the general server-side NASDAQ CTCI interface. Supports ACT simulation (trade reporting, comparison for clearing and risk management), SuperMontage trading facilities, and ACT simulation of order routing between order-entry and market-maker firms
- SDP Trading Service (NWII) is a general server-side NASDAQ SDP interface. Supports all session level services including regression and route testing

- QIX is a new NASDAQ protocol that replaces the old NASDAQ API. Supports order entry, cancel, and cancel/replace as well as quote entry/update for the NASDAQ Market Center for NASDAQ and exchange-listed trading, and the OTCBB. QIX handles order delivery/execution and unsolicited messages (UM)

Regional Simulators

Regional simulators available in the TradeTest toolset include the INET (Instinet) ECN Simulator (ITCH,OUCH and INET-FIX), the BRUT ECN Trading Simulator (ITCH and BRUT-FIX), and the ARCA ECN Exchange Simulators and data feeds (ArcaBook and ARCA-FIX).

Stress and Capacity Simulator

The TradeTest Stress and Capacity Simulator features a powerful order generation engine that makes it the perfect tool for precise stress and capacity testing. The simulator facilitates algorithmic generation of orders based on configuration criteria such as total orders, book orders, executable orders (to stimulate trading activity), price variance, and specific order types.

This approach generates realistic and reproducible spreads of orders, with no limits on capacity that can be distributed across one to 200 FIX client sessions. Aggregate message rates exceed 12,000 orders per second from a single CPU. TradeTest FIX session configuration supports precise control of message rates for individual sessions. A highly flexible solution, the TradeTest Stress and Capacity Simulator provides 38 configurable parameters. The interaction of these parameters is an essential component to successful stress and capacity testing, and only TradeTest delivers this level of granularity.

External Bridge Simulator

Based on an open architecture, TradeTest includes an External Bridge Simulator that enables internally-developed test tools, or tools from another vendor, to be fully integrated into the test case automation. Supported interfaces include:

- COMMAND script execution
- SQL script execution
- SILK integration
- WINRUNNER integration
- MAINFRAME JCL integration

Specifications

Supported Platforms: Pentium 4 PCs and above running Windows 2000, Windows NT, Windows XP, XP Pro, Windows 2003 Server, and Linux

Additional Requirements: Customer-provided MS SQL

SPIRENT
Communications