

# **International Securities Exchange**

**Technical Overview**

## **The Electronic Market**

### **Overview**

The International Securities Exchange ("ISE") operates a totally electronic marketplace for the trading of equity options. Orders and quotes are entered into an orderbook, which is maintained in the ISE central exchange system. Trades are executed automatically when orders and quotes match. The central exchange system also includes a database where class and series information is stored. This database information can be retrieved by member applications.

The ISE's members access the market from workstations connected to the central exchange system via a high-speed network (see Figure 1). Traders can enter orders and quotes and view market information from the workstations or their own open interface-based applications.

### **Central Exchange System**

The central exchange system software is supplied by OM Technology, a Swedish company with worldwide trading technology experience. This application runs on multiple servers and uses clustered databases, providing a high degree of reliability, flexibility and scalability. All transactions are processed in parallel across dual data centers, providing complete redundancy.

The software operates on Open VMS and Windows NT platforms, using Compaq's Reliable Transaction Router (RTR) for transaction management and Oracle Rdb as the database engine.

The system operates on Alpha and Intel-based servers supplied by Compaq Computer Corporation.

### **Trader Workstations**

The ISE supplies two Windows NT based trader workstation products for entering transactions and viewing market information:

- The CLICK Trade® workstation, used by broker/dealers for order entry and management
- Torque, a market maker workstation used to enter and maintain quotes

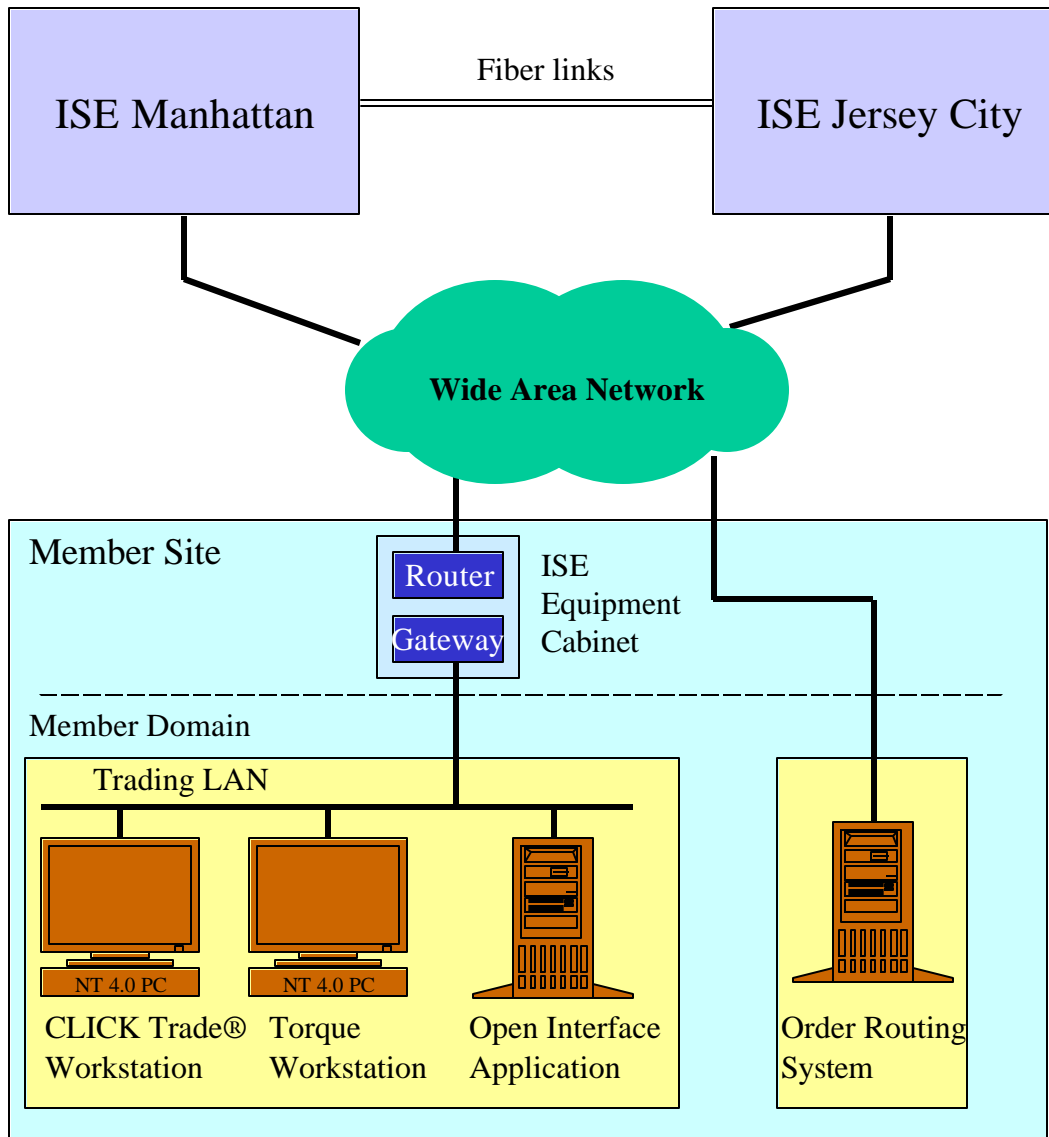


Figure 1. ISE System Overview

## **Open Interface**

The Exchange's system has a proprietary open interface that allows members to connect directly to the ISE using applications developed by members or third party vendors. The open interface specification is available from the ISE's Member Services department. Through the open interface, members have the flexibility to use their own or third party developed applications alone or together with the Exchange-provided trader workstations.

Applications developed to the ISE open interface must pass validation tests to ensure compliance with system and business requirements. The validation tests are described in the ISE's open interface specification. Following the ISE's approval of this software, a member may connect the application to the trading LAN in the same way as ISE supplied applications: CLICK Trade® and Torque.

## **Network**

Members connect to the Exchange via a high capacity network, with multiple links over diverse routes for full network and data-center redundancy. In addition, the ISE adheres to industry best practice for security.

## **Services and Products**

### **Market Access Service**

The ISE delivers a standard, pre-configured cabinet to each member site. This cabinet contains all equipment including gateways, routers, hubs, and data lines necessary to connect the member site to the Exchange. The ISE is responsible for ongoing maintenance of this equipment.

The TCP/IP address of each workstation or device connected to a gateway must be configured on the central exchange system. Each individual user must also be configured in the central exchange system with a user-ID and password.

If the workstations are to operate in the member's shared network, the member supplies the TCP/IP addresses to be configured. Only static addresses are permitted.

To connect to the Exchange, two data lines and a communications cabinet are installed at the member site. The cabinet must be placed in an environment with adequate ventilation; it cannot be placed into a sealed area such as a closet. The cabinet requires power from dual 20-amp, screw lock power sockets. This electrical service must be installed in advance of the delivery of the communications equipment.

## **Trading Products**

### ***CLICK Trade® Workstation***

Electronic Access Members (“EAM”) may use the CLICK Trade® workstation to view the best bid and offer and last sale for each series, and to enter and manage all order types supported by the ISE.

The ISE provides the CLICK Trade® workstation software; the EAM supplies the PC hardware and LAN connection back to the communication cabinet (see Figure 1).

The minimum requirements for the PC are:

- Intel compatible PC with 450 MHz CPU, 128 MB of memory
- 4 GB disk drive
- 17 inch monitor (a 21-inch monitor is recommended)
- graphics card with 8 MB of memory
- 10 Mbps network card
- Windows NT 4.0 workstation, with service pack 4
- CD-ROM
- Standard 101 keyboard and mouse

The CLICK Trade® workstation is configured to receive market updates for up to 30 stock options at one time. This can generate a high network load; therefore, dedicated network connections and PCs are recommended.

To operate CLICK Trade® workstations, members must have at least a ½ T1 capacity (768 Kbps) network connection to the ISE. The ISE will arrange for the installation of the network connection to member sites, as part of the Market Access Service.

Members may contact the ISE for further information regarding LAN design.

### **➤ *CLICK Trade® “Lite” Workstation***

A low volume version of the CLICK Trade® workstation is available to members seeking to minimize communications costs.

CLICK Trade® “lite” is configured to maintain a small number of stock options (approximately two) in memory to limit traffic associated with the market information feed. It should be noted that this configuration can result in delays to the updating of market information during active situations. Requesting information on a class not already in memory will take longer than in the standard CLICK Trade® workstation.

Members can operate CLICK Trade® “lite” on a 128 Kbps line with a maximum of two workstations at the site.

In all other respects, CLICK Trade® “lite” is the same as the standard CLICK Trade® workstation.

## ➤ **Torque Workstation**

Market makers may use the Torque workstation, a sophisticated analytical system that sets and maintains market maker quotes. Torque uses various pricing models to continuously recalculate quote values as underlying stock prices change.

The ISE provides the Torque workstation software; the member supplies the PC hardware and LAN connection back to the communications equipment.

Torque executes significant analytical calculations in a time critical manner. The ISE recommends higher-end PCs for this purpose. The minimum requirements for the PC are:

- Pentium Compatible, 800 Mhz CPU, 256 MB of memory
- Dual Processor optional
- 9 GB fast SCSI disk drive, 10,000 RPM
- Dual 19 inch flat screen monitors
- Graphics card with 8 MB per screen; (note: dual head support is required for two monitors)
- 100 Mb network card
- Windows NT 4.0 workstation, with service pack 4
- CD-ROM
- Standard 101 keyboard & mouse

Market makers require at least a ½ T1 capacity (768 Kbps) for trading and market data broadcasts. Those members making markets in more than one group of sixty options will require a full T1 (1,536 Kbps).

## **Central Exchange System**

The central exchange system consists of various components operating on multiple hardware servers running under the supervision of an enterprise management system. Each component is duplicated and runs in parallel at the alternate processing site (see Figure 2).

The major components are:

### **Market Place (MP)**

MP stores orders and quotes in the central orderbook. When a match occurs, trades are generated. MP stores its data in memory to maximize performance. This component is partitioned over multiple Alpha servers, which provides for reliability, flexibility and scalability. A full event log of every transaction is maintained and accessible.

### **Common Data Base (CDB)**

CDB stores largely static data such as class and series information, user details and network configurations. Trade details are also stored on this node. CDB resides on a multi-node Alpha cluster.

### **Feed Server (FS)**

FS receives price feeds from CTS, CQS, NASDAQ and OPRA, and sends the ISE's market information to OPRA and OCC. FS also operates on Alpha servers.

### **Supervision (SV)**

SV stores details of every transaction and examines each to verify compliance with trading rules. SV runs on a multi-node Alpha cluster.

### **Reliable Transaction Router (RTR)**

RTR, a Compaq supplied software product, operates on a set of Alpha processors. RTR routes the transactions from the member's application to the appropriate servers, provides parallel processing of transactions across data centers, ensures transaction integrity, and reroutes transactions in the event of hardware or network failures.

### **Central Information Tunnel (CIT)**

CIT servers reduce the network bandwidth required by filtering market broadcasts so that each member receives only the information requested. CIT servers operate on multi-processor Intel-based computers supplied by Compaq.

### **Order Routing**

The order routing servers permit members and order routing service providers to connect to the ISE using existing protocols.

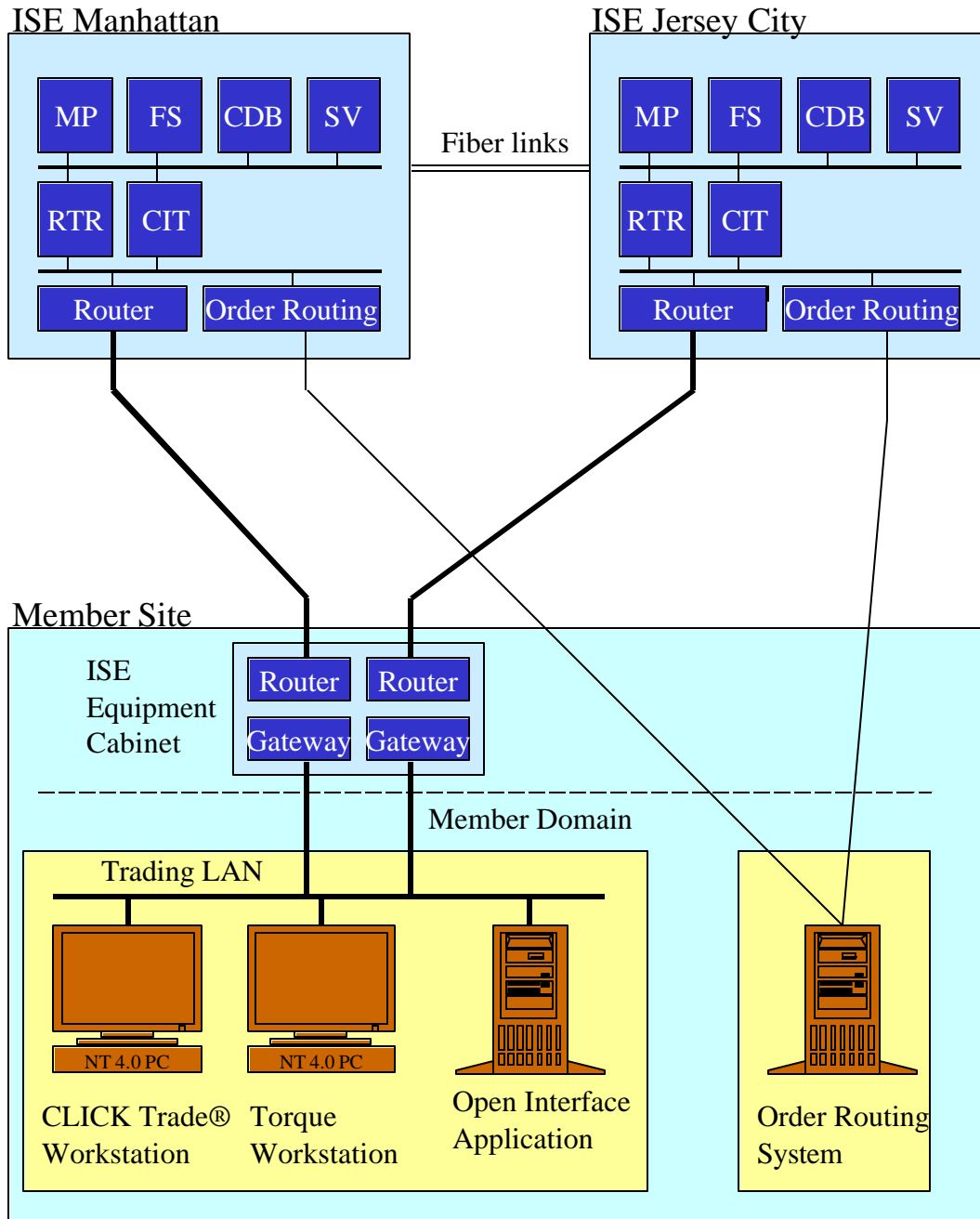


Figure 2. ISE System Architecture



## Transaction Processing Cycle

A transaction is a sequence of events where a member's workstation or application sends an open interface message to the central exchange system, it is processed and a reply is returned.

The ISE network assures the secure processing of transactions and the prompt delivery of market information to the member.

The steps in processing a transaction are outlined below:

- The workstation sends a TCP/IP message to an ISE gateway located at the member site
- The gateway forwards the message to one of the central RTR nodes. RTR records the message and forwards it to the correct server where the transaction is executed and logged to a journal file. The response is then sent along the same network link back to the gateway
- The gateway forwards the reply, with processing status, to the trader workstation or open interface application

When the ISE's best bid or offer ("ISE BBO") updates, a message is broadcast to all participants with the new ISE BBO. There are a large number of ISE BBO broadcasts, for which a full T1 connection is required. To allow access with lower bandwidth requirements, the CIT servers filter the ISE BBO broadcast to send only the data requested by the member firm.

For example, a trader brings up a Price Information display on XYZ options:

Step 1: The trader workstation first advises the gateway to access all XYZ related broadcasts. The gateway then informs the CIT server to send XYZ broadcasts. The trader workstation then sends a query to the central system to retrieve the current price of each series and the underlying, which are then displayed on the workstation.

Step 2: When the next change in the ISE BBO occurs, a message is broadcast across the ISE central processing network. The CIT server reads the message indicating a change to the ISE BBO. If the message relates to XYZ, it is sent over the data line to this member's gateway. Broadcasts are only sent once to each site, regardless of the number of workstations monitoring that class.

Step 3: The gateway at the member's site receives the broadcast message and queues it for each user application, such as a trader workstation or back office application, that has requested to see information relating to XYZ.

Step 4: The trader workstation polls the gateway for any updates, receives the broadcast message, and updates the price information display.

It is important to consider that the central system only transmits data over the wide area communications network once; only broadcasts requested by member applications are transmitted. The gateway then repeats that data to each application on the member's trading LAN monitoring that option. Note that the gateway never "pushes" information on to the member's network; rather, the member's application must read the information from the gateway.

## **Recovery Capability**

All hardware, software and network components in the central exchange system are duplicated and are designed to recover quickly from any single point of failure. In most failure scenarios, the system will continue to operate without interruption.

The member site is connected to each ISE data center, using data lines over diverse paths. A network failure is automatically overcome by the routers at the member site, redirecting the traffic to the alternate ISE site via the backup line.

The equipment installed by the ISE at the member site is duplicated. The communications cabinet contains at least two routers and two gateways. The routers are HSRP enabled; if one router fails, the backup router takes over and redirects the traffic through the alternate data line. This does not require manual intervention by the member's support staff.

In the event of a hardware failure to any one component in the cabinet, the alternate component has sufficient capacity to handle the full traffic load. An ISE-authorized service technician can then replace the faulty unit at a convenient time.

The CLICK Trade® and Torque workstations establish a TCP/IP connection to a designated port on a specified gateway. If the gateway fails, the user session terminates. The user must close the application and reconnect via the alternate gateway. To accomplish this, two program icons appear on the PC desktop, each configured to connect to separate gateways.

To provide additional backup, a second set of lines and equipment may be installed at a member's alternate site which can then be linked with the member's own network connection. Trader workstations can then connect to gateways at either site.

Server based applications may use backup server configurations, which should be set up in advance and tested regularly.

For server applications with hot standby facilities, additional user-IDs should be configured so the backup server is connected and fully operational through the backup site.

Member Services may be contacted for further assistance.

## Capacity Planning

Each market maker can continually update quotes as the underlying stock price moves using a "mass quote" transaction.

When market makers update quotes, the updates are grouped by the central exchange system into mass quote broadcasts and sent out over the network. The ISE estimates the ISE BBO broadcast feed to be approximately 1.5 to 2 Mbps for all 600 options.

The network only transmits the ISE BBO to a member if the member application has subscribed for that option. Market makers operating in one group require a minimum of a ½ T1 (768 Kbps) network connection. Members who are market makers in multiple groups of options require a full T1 (1,536 Kbps) network connection to carry the full ISE BBO broadcast. If additional bandwidth is required, more T1s can be installed.

EAMs using the standard CLICK Trade® workstation are configured with a ½ T1 data line. Each CLICK Trade® application can handle up to 30 options; therefore, multiple workstations can subscribe to a large portion of the broadcast traffic. As the CLICK Trade® user moves between options, the application queries and subscribes to the new options, and drops the subscription for the oldest. The ISE expects a ½ T1 to be sufficient to carry the expected load for up to five CLICK Trade® workstations.

EAMs that use CLICK Trade® "lite" require a 128 Kbps line. CLICK Trade® "lite" limits subscriptions to two options at a time. Dynamic updating of market information can be delayed during active market situations. When a trader views a new option, the terminal will drop the broadcast subscription for the first option. While broadcast traffic is minimized, switching between options takes longer for the information to be retrieved from the central exchange system.

A function of the gateway is to repeat the broadcast data to each workstation that is viewing that data. While members use a ½ T1 to receive the ISE BBO broadcast, it is possible that the local traffic could be greater as the broadcast data is sent to each workstation. The ISE provides the following guidelines:

- Allow 300 Kbps per workstation for traffic on the local LAN between the gateway and the CLICK Trade® and Torque workstations
- Allow 128 Kbps per workstation for low speed CLICK Trade® "lite" workstations

**Important Note:** For applications developed in-house or supplied by third party suppliers, members must ascertain how the application subscribes to the broadcast data to estimate the network capacity required on their in-house trading LAN.

## **Open Interface Development**

The ISE central exchange system has a proprietary open interface that allows members to develop and connect applications such as:

- Trading applications which enter orders and perform all of the functions that are available through the CLICK Trade® workstation
- Quoting applications that enter orders and perform all of the functions that are available through the Torque market maker workstation
- Back office systems that obtain trade information directly from the ISE

The open interface uses a proprietary Application Programmers Interface (“API”) library to send trading commands to the central system and to receive executions and market information from the central system.

Members may develop applications for specific purposes, which can be used in conjunction with the CLICK Trade® workstation, or use trading products supplied by third party suppliers.

The ISE provides an open interface manual, which describes how to interact with the open interface and the formats of each transaction.

Connection to the ISE open interface requires that the developer enter into an agreement with the ISE. The ISE then provides the developer with the API subroutine library and access to the ISE member test system. The ISE also makes available to developers a demonstration program, which provides an example of how each transaction can be programmed.

Access to the member test system is via a 56 Kbps ISDN link. This network is separate from the production network.

Contact Member Services for more information on the open interface or to obtain a list of independent software suppliers with commercial products that connect to the open interface.

## **Existing Order Routing Systems**

In addition to the open interface capabilities, members with an existing order routing system may utilize a protocol conversion facility provided by the ISE. This allows the connection of order routing systems to the ISE without the need to develop to a new protocol.

The interface to the order routing server is on a low speed network connection, separate from the high-capacity quoting and trading network.

## **What Next?**

### **1. Establish contact with the ISE**

Assure that Member Services knows the correct technical contact for your organization. Be certain your particular requirements have been discussed with the ISE.

Ask if your trading staff is aware of the ISE and determine if they would like a demonstration of the trading applications.

Check that the ISE has the address of your data centers and trading desks. This allows the ISE to record the correct address and perform a site survey. The ISE telecommunications supplier will then assure that they have connectivity to your building. Check that your backup site, if you are using one, is also recorded and surveyed.

### **2. Confirm ISE Trading Services**

Finalize the type of service and how many CLICK Trade® and Torque workstations are required. Specify if you require an open interface and/or an order routing connection. Confirm the location of the ISE communications cabinet. Check that you have adequate space, power and ventilation. Note the requirement for two 20-amp screw power sockets.

For users of order routing systems, contact Member Services to determine if your order routing system or service is supported by the ISE. The ISE can then begin the process of establishing connectivity.

If you wish to assign network addresses, advise the ISE of the addresses to be configured.

### **3. Complete the Access Agreement**

The ISE Access Agreement confirms the services to be installed. *The ISE will not commence the installation of trading services until the Access Agreement is executed.*

### **4. Member Site Requirements**

Purchase and install PCs according to the ISE's specifications. Install a trading LAN, which will connect the PCs to the ISE communications cabinet.

Arrange for the ISE to install communications cabinets and lines. Connect the trading LAN to the communications cabinet. Install trader workstation software, and assure connectivity to the ISE's central exchange system.

### **5. Testing and Implementation**

Contact the ISE to schedule and conduct systems testing.

Ensure that trading staff are trained and that market makers have taken and passed the Designated Trading Representative ("DTR") examination.

## **ISE Contacts**

**Richard Pombonyo**, VP Marketing – first point of contact for member firms

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**Gregory Maynard**, VP Member Services – assistance with all aspects of technical connection to the ISE

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For more information, visit our web site at [www.iseoptions.com](http://www.iseoptions.com) or email us at [mail@iseoptions.com](mailto:mail@iseoptions.com).

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