Interactive Brokers Software Architecture

IB's software architecture is designed for low latency and high throughput. The SMART router is distributed across multiple hosts in order to provide sufficient capacity. New resources can be added to the system overnight. Each order passes through three active hosts the first being the customer-side communications interface, the second being the SMART router and the third being the exchange-side communications interface. This architecture allows IB to achieve order acknowledgement times of 75 milliseconds and order-to-trade times of 130 milliseconds with the ISE (measured at IB's customer-side communications interface).

Network

IB operates OC-48 SONET rings with each of two carriers at its Greenwich data center. IB is connected to each carrier by two diversely routed fiber optic facilities. Each of the four fiber optic facilities has a capacity of 2.5 gigabits per second. In the event of a fiber failure or carrier failure the system automatically restores service via an alternative data pathway. Some of the links are point-to-point services while others employ advanced carrier based IP services. The latter services have greater resiliency within the carrier's network.

IB is a direct subscriber to the OPRA data feed as well as to the underlying stock feeds from the exchanges and ECNs. For OPRA, IB operates redundant OC-3 facilities (155 megabits per second) that are connected to the local area networks at SIAC and IB using gigabit interfaces.

The local area network (LAN) within IB's Greenwich data center is redundant from its connection to the wide area network down to each host in the system. Each of the two data circuits that form a redundant connection is connected to one of a pair of redundant routers. IB uses link state routing protocols and other advanced routing protocols in order to recover automatically from a link or router failure. IB employs redundant layer 2 and layer 3 switches in order to effect a distributed switching environment in its data center. Each host is equipped with two network interface cards so that it will still be connected to the network regardless of any single wide area network link, router or switch failure.

Systems

IB employs a number of hardware architectures for its various systems. But the predominant type for the order routing system is high speed LINTEL running C++ applications.

IB employs RAID 5 disk clusters with redundant controllers and fiber switches. Redundant high availability servers manage file systems while Oracle database access is handled by multiple query processing hosts per application.

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IB runs redundant market data hosts for OPRA and the underlying stock market data feeds for NASDAQ, NYSE and AMEX. Each host in a redundant pair has its own set of real time data such that the passive host can take over in the event that the active host fails.

IB is in the final stages of testing of a new sub system that will provide redundancy in the client access channel. The first component of the new system will automatically map a client FIX connection around a failed firewall host between the client's host and IB's customer-side communications interface host. The second component will automatically restore IB's customer-side communications interface process on a secondary host in the event that the primary host fails. This system will be deployed in October of this year.

IB is in the process of building the ability for its exchange-side communications interfaces to automatically recover on a secondary host in the event of a failure of the primary host.

Very importantly, IB has the ability to dynamically move orders from one options exchange to another automatically in the event that IB cannot communicate with an exchange for any reason. Once the system software observes that an exchange is unavailable the SMART router is used to reroute the orders on the failed exchange to the then best alternative.

Facilities

IB has two diversely routed utility power feeds that connect to a dedicated transformer at its Greenwich data center. Independent uninterruptible power supplies, power distribution modules and computer cabinet power distribution modules make up redundant, uninterruptible power channels. Each component of the system is connected to a central monitoring facility. Each uninterruptible power supply is fed emergency power from its own one-megawatt generator. Either generator alone has sufficient capacity to operate the data center plus all of the office space at IB's Greenwich head quarters.

Each host is equipped with redundant power supplies each of which is connected to one of the power channels. Any gear that contains only one power supply (e.g. certain routers) is fed redundant, uninterruptible power via high-speed automatic transfer switches. In this way no computer or communications equipment will lose power in the event of a loss of utility power or the failure of a single power distribution system component.

IB has sufficient cooling capacity in its Greenwich data center to operate normally with the failure of any one of its computer room air conditioning units.

IB has deployed two fire suppression systems in its Greenwich data center. First a chemical fire suppression system using FM200 and second a dry pipe, pre-action sprinkler system.

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Operations

IB designs, builds and operates it own systems. The brokerage system operations group is on site from 15:00 Sunday to 20:00 Friday. In addition systems, network and facilities telemetry systems alert staff of critical events on a 24x7 basis.

IB's operations model is built on a layered, peer-to-peer communications model. Namely a client's business management interacts with IB's sales representatives, a client's trading desk interacts with IB's professional services group and a client's technical operations group interacts with IB's technical operations group. At IB the latter group has escalation paths to the network group, the computer systems group as well as to the software engineers that have built the operating software.

Because IB builds and operates it own systems it always has the trained staff on hand to service any operating problem. The computers and displays in the IB operations room are fed from the uninterruptible power supply. The technical operations group monitors system operation and performance using IB's internal event reporting system. The systems and network groups each monitor system operation using a combination of commercial and proprietary tools. All three groups are involved in the monitoring, planning and implementation for system capacity.

Disaster Recovery

As one can see from the above, the IB Greenwich data center and its systems are highly resilient to failure. IB is in the process of completing a system for the purpose of business continuity recovery in the event its Greenwich data center becomes inoperable or unreachable. This site will contain a database replica of the trades completed prior to the failure of the Greenwich site. This facility is not equipped to undertake new transactions for computer-to-computer clients. trade.