

# Global Electronic Exchange Places Premium on SAN Reliability

## BACKGROUND: CME GROUP

CME Group ([www.cmegroup.com](http://www.cmegroup.com)) is the world's largest and most diverse exchange. Formed by the 2007 merger of the Chicago Mercantile Exchange (CME) and the Chicago Board of Trade (CBOT), CME Group serves the risk management needs of customers around the globe. As an international marketplace, CME Group brings buyers and sellers together on the CME Globex electronic trading platform and on its trading floors. CME Group offers the widest range of benchmark products available across all major asset classes, including futures and options based on interest rates, equity indexes, foreign exchange, agricultural commodities, energy, and alternative investment products such as weather and real estate. CME Group is traded on the New York Stock Exchange and NASDAQ under the symbol "CME".

## CME Group Uses Emulex for Critical Electronic Exchange Connectivity Across 200TB SAN in Linux Environment

The Chicago Butter and Egg Board has come a long way since 1898, when it was founded as a trading exchange for agricultural futures contracts. Since its founding the exchange has evolved. Today, the company is known as the CME (Chicago Mercantile Exchange) Group and is the world's largest derivatives exchange offering traditional open outcry trading as well as electronic trading through its powerful system. The bids and calls that continue on the trading floor now also take place at millisecond speeds on CME Globex,<sup>®</sup> the electronic trading platform of CME Group, with each data transaction recorded and stored to create the legal record of the trade. As a result, the pressure cooker environment of the futures trading floor has evolved to one where equal pressure lies with the team responsible for the performance of the computer networks and real-time data storage technology that ensure smooth operation of the exchange's round-the-clock trading platform.

Clearly, electronic trading is driving the futures markets of the 21st Century. In 2006, CME Globex recorded a global volume of 1.015 billion contract trades, representing more than two-thirds of CME Group's total trading volume of \$827 trillion in notional value in 2006. This is an increase of more than 31 percent from 2005. And this double digit growth is the norm for CME Group, which has seen its volume leap by 300 percent (compounded rate) since 2000, when the total volume of contracts traded was 34.5 million.

The dramatic growth in trading volume translates to enormous storage requirements. CME Group doubled its storage array capacity last year, while concurrently evolving its Storage Area Network (SAN) from a single, central architecture to a two-tier platform with disk and virtual tape arrays. With continued capacity increases, and absolutely critical requirements for I/O performance, CME Group chose Emulex LightPulse<sup>®</sup> Host Bus Adapters (HBAs) for its SAN connectivity.

### Millions of I/O Transactions Daily

Each electronic contract traded by CME Group involves four to ten computer transactions, generating enormous traffic between servers and storage. In electronic trading, response time is measured in milliseconds, placing a premium on I/O performance in terms of both speed and data integrity.

Joel Kulesa, SAN architect at CME Group, notes that, “The mission critical nature of the transaction records makes small transaction performance and reliability critical factors in choosing SAN components.” The exchange is currently deploying Solid-State Disk (SSD) storage in its data center to further boost performance, and tests of Emulex HBAs on these platforms confirmed exceptional performance under high workload conditions.

The proven track record of the Emulex LightPulse HBA family was another consideration in CME Group’s evaluation. Three years of data collected from Emulex LightPulse HBAs in the field have recorded an unparalleled 5.8 million hours mean time between failure (MTBF).

CME Group is installing the Emulex LightPulse PCI Express HBAs, in a rolling implementation as part of its regular system upgrade and maintenance. Ultimately, up to 500 dual-attached host port connections between servers and storage assets will utilize Emulex HBAs.

### Enterprise-Class Linux Support

The data centers supporting Globex are comprised of more than 4000 Linux servers, primarily 1U form factor, 64-bit processor systems. Following an implementation strategy to assure resiliency, the switching network is heterogeneous and routed across three data centers (in separate locations within a 200 km radius).

“Emulex LightPulse HBAs were an easy fit for our data center operations,” said Kulesa. “Strong support for all leading Linux distributions also simplifies implementation in the dynamic environment of the CME Group data center.”

Recognized as a technology leader in the Linux community, Emulex was the principal architect and now maintains the vendor-agnostic FC Transport layer that is part of the Linux kernel. Emulex also helped design sysfs (System File System), which enables the use of third-party and “homegrown” system administration tools, such as perl scripts. CME Group uses internally developed scripts for its SAN deployment, which leverage the sysfs-compliant drivers provided by Emulex.

“Overall, the architecture of the Emulex LightPulse HBA Linux software stack creates a strong foundation for the CME Group SAN architecture,” said Kulesa. Emulex uses a “common driver” model to preserve HBA investment by supporting new releases without the need for hardware replacement. A Service Level Interface (SLI™) allows new firmware deployment on a single server or an entire network. Emulex’s dedicated Linux engineering team provides speedy implementation of new Linux kernel features as they are distributed, such as sysfs and Device Mapper MPIO multipathing.



### Built for Reliability

In March 2007, average daily volume handled on CME Globex reached 6 million contracts. To the casual observer, these trades are handled in the blink of an eye, with the average round trip for a futures product measuring 31 milliseconds, and options product trades taking place within an incredible 6.25 milliseconds. These numbers underscore the critical importance of a server and storage network with 99.999 percent reliability.

In line with the requirement for five-nines reliability in its trading system, the SAN team places a strong emphasis on failover rates in the event of a data path blockage. During initial evaluation of Emulex LightPulse HBAs, Kulesa and his team

participated in advanced training classes with Emulex experts in SAN implementation. After a focused discussion, CME Group concluded that Emulex LightPulse HBA configuration options for path failover were superior to alternatives and testing prior to deployment confirmed better overall performance.

"Ultimately, the expertise of the Emulex team and commitment to go the extra mile to support CME Group contributed to our decision to implement Emulex LightPulse HBAs throughout its data centers," said Kulesa. With the continued rapid growth of worldwide trading volume, assured performance and reliability of the SAN solution gives the centuries-old open outcry system of auction trading a solid foundation in the digital age.

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