

### **Business Case**

Calcutta Stock Exchange was founded in 1908 after a clutch of Bengali families and several others with the then big British brokers had a meeting as early as 1905. They decided to secure a 'meeting place for business', which finally was started in the ground and mezzanine floors of the current location. Calcutta Stock Exchange has emerged as one of the largest bourses in the country. Investors from the Eastern Zone are also at the forefront.

The building at 7, Lyons Range, Calcutta was constructed in 1928 and has been the office of the Stock Exchange till date. The exchange which started with about 150 members can now boast of more than 900 consisting of several corporate and institutional members. The number of companies listed on the Exchange is more than 3,500.

Till 25 February 1997, CSE used to operate in the outcry mode wherein member brokers used to gather in the trading hall of the exchange and execute trades by means of raising orders and matching them verbally. These were later formally recorded.

### **Challenge faced by the customer**

The manual form of trading had several limitations. Some of them are given below:

1. Brokers did not come to know of the best rates of bids and offers.
2. There was no concept of stoploss.
3. There was no concept of circuit filters or circuit breakers
4. There was no concept of floor or ceiling for an order.
5. Traders were not aware of volumes of shares being ordered / traded.
6. There was no transparency in the system.
7. Default of delivery either of shares or money could not be tracked easily.
8. On many occasions, bad delivery of shares would take place.
9. Settlement did not take place in the proper manner.
10. Surveillance was almost non-existent.
11. Exchange earnings from the trades were not properly accounted for.

### **CMC's solution and implementation**

On 26 February 1997, the automated on-line trading system (CSTAR) was inaugurated by the then Chief Minister Mr. Jyoti Basu. It initially started with 101 'B' group scrips and from 7 March 1997 it was trading in around 3,500 scrips consisting of 'A', 'B' and 'Permitted' groups.

The CSE Screen Based Trading & Reporting system (CSTAR) is designed to be a user-friendly, screen-based computer trading system developed by CMC Ltd. for the use of The Calcutta Stock Exchange Association Ltd. The brokers are connected by the local area network and wide area network using the state-of-the-art with optical fibre cables and VSAT technology and Router/Modems to hook up individual terminal with the main system

CSTAR allows entry of orders and quotes, displays the best rates for scrips, matches transactions entered and provides status information apart from other facilities.

The CSTAR application S/W encompasses the following modules:

Trading, Surveillance, MOP, Badla (not in use at present), Auction, Margin, Settlement, AWACS Feed and Reuter Feed.

The core module of trading was taken from the BOLT application. The rest of the modules including odd-lot trading, demat trading, custodian trading, trade for trade, Reuters data feed, etc., were developed afresh by CMC.

### **Trading Module**

Members may enter Orders (buy or sell), Quotes and Odd Lot Orders (buy or sell), which may result in trades depending on the matching logic. They may view their Trades, Transaction Log and Net Positions.

As the orders and quotes pour into the system, the back end servers accepts, validates and matches the transaction requests as per the trading rules and regulations of the Exchange. If the incoming sell rate is lower than or equal to the best buy OR if the incoming buy rate is higher than or equal to the best sell, a trade occurs. Otherwise, the incoming order is accordingly kept as pending for later processing. Fresh orders are processed on the basis of first come first served logic. Pending orders are matched as per the best fitting rate for the fresh order. If there are multiple such orders, then FCFS is applied for Trade generation. The market picture is accordingly refreshed and relevant database is updated. Members are intimated whenever trade has occurred against their requests.

### **MOP Module**

It is a special function module for Market Operations Department. The MOP module allows MOP users to perform various activities. A few of them include:

- Master Maintenance, e.g., Scrip/Company/Member/User/Session, Calendar/Settlement, Calendar-Addition, Updation, Deletion, Retrieval, etc.
- Report download facilities
- NSDL/CDSL related activities

### **Surveillance Module**

This module is specifically targeted towards the monitoring department of CSEA. This module involves:

- Parameter setting for Scrips, Users, etc.
- Circuit filter limit setting
- Margin limit retrieval and updation
- Scrip/Company/User/Member Suspension and Reactivation
- Market Halt
- Report Download, etc.

### **Auction Module**

Auction in the literal sense refers to public sale where different rates of bids are quoted and goods are sold to the highest bidder. With respect to the trading of shares, auction implies the same thing with a slight difference. In this case, sell offers are placed (unlike buy offers in the general auction) and the lowest bidder gets to sell his shares.

In the normal course of trading, registered members of the stock exchange pursue buying and selling of shares in the secondary market. The members enter Buy and Sell Orders and Quotes against which trades take place. The buy and sell positions are settled at the end of every settlement. Depending on the buy/sell position, a member gains a buyer or seller status. There are fixed dates assigned by the exchange for settling their dues. A Member, who has a buyer status, receives shares from a member, who has a seller status for a particular scrip, listed at the Exchange.

In case a member fails to deliver all or part of the total shares he was supposed to, auction is held against those shares. The member who fails to deliver shares is called the "Defaulter" for those shares in the settlement. The member who failed to receive the shares due is called the "Buyer".

### **Categories of Auction- Physical, Demat and Bad Delivery**

Auction in the share business can arise out the following situation.  
This condition can again be classified into 4 groups:

Short Delivery (SD)

This condition arises when the defaulter partly delivers and fails to deliver the remaining quantity of shares.

Non Delivery (ND)

This condition, as the name suggests, occurs when then seller has completely failed to deliver the amount of share he is supposed to deliver.

**Margin Module**

Margin is collected by Stock Exchange to account for risk of a deal not being honoured by a member. From investor's point of view, it allows him to leverage their purchases or sales by depositing the margin amount through which he conducts the transactions. The member, in turn has to deposit margins collected from the clients to the clearing house of Stock Exchange.

**Settlement Module**

On a predetermined period of time set by the exchange as per SEBI guidelines, members are expected to settle their positions. A unique settlement number identifies every settlement. Since the processes are run by batch method, this can only be checked by comparing input to settlement against the settlement reports or output of a component in settlement module. Initially, the settlement module was developed on the Tandem platform and at a later date it was redeveloped on a Unix platform with Oracle as the database.

**AWACS Module**

Online & offline data feeds for AWACS on orders placed and trades generated. The same is generated for Surveillance Department for their detailed analysis.

**Reuter Feed Module**

Feed containing information related to trades and Index values of NSE and BSE are obtained from Reuters and broadcasted to member terminals. The same categories of information are transmitted from CSE.

Over the years since the first trading day CSTAR has gone through many changes both in terms of software and hardware.

**The Main Trading (Production) Server**

**Hardware**

The main Trading Server is HP NonStop S74000 Server. This server is based on a unique technology of fault tolerant and data protection, which has made it popular in stock exchanges and banks across the world, for its online transaction processing environment. Almost all the major stock exchanges use this server for their online trading. The server is guaranteed against single point of failure and ensures high availability of the application in conjunction with the NonStop Kernel Operating System.

**Original configuration of the Server before downsizing**

8 nos. of RISC CPUs, each with 2 GB of ECC RAM.

8 ports of 10 Mbps and 8 nos. of 10/100 Ethernet ports.

22 pairs of 8.8 GB USCSI Hard Disks in mirror configuration, which are accessed via two dual ported internal SCSI controllers.

**Current configuration of the Server after downsizing (w.e.f. Nov 2004)**

4 nos. of RISC CPUs, each with 2 GB of ECC RAM.  
8 ports of 10 Mbps and 4 nos. of 10/100 Ethernet ports.  
20 pairs of 8.8 GB USCSI Hard Disks in mirror configuration, which are accessed via two dual ported internal SCSI controllers.

All the CPUs and other components are interconnected via fault tolerant dual ServerNet Fabrics.

### **System Software**

The Operating System is NonStop Kernel version G06.18. The database used is called NonStop SQL/MP. Tandem C (compatible with ANSI C) is the application development language. Other softwares include database protection and recovery software (TMF/MP), system management and diagnostic software (such as SCF, TFDS, FUP, VIEWPOINT, VIEWSYS, TSM, PEEK etc.), which are all bundled along with the operating system.

### **System Architecture**

The design of the server is based on the concept of single point fault tolerance. For a failure of any major single component (CPU, controller, disk etc.) the on line transaction-processing environment is not affected. This unique feature is achieved by the combination of Non Stop Hardware and System software in tandem.

The hard disks are mirrored pairs. From the operating system point of view there exists a single logical disk for every mirrored disk. Data is written to both the disks simultaneously and read from one of the disks.

There are four physical paths from each CPU to a mirror pair disks. Two, via one controller and two, via the other controller. So access is guaranteed for a controller or hard disk failure.

All system and application processes run as pair in separate CPUs as primary and backup processes for providing fault tolerance and update each other periodically. In case of a CPU failure the other process keeps on processing.

### **The Development Server**

The development server is also a HP NonStop S 74000 Server with following configuration:  
2 nos. of RISC CPUs, each with 2 GB of ECC RAM.  
8 ports of 10 Mbps Ethernet ports.  
6 pairs of 8.8 GB USCSI Hard Disks in mirror configuration, which are accessed via two dual ported internal SCSI controllers.

These two servers are interconnected in LAN via HP propriety EXPAND link over TCP/IP.

All the new developments and testing is done in this server prior to live implementation in Production server.

### **The Settlement Server**

The settlement system currently runs in a HP UX 11 based Oracle 8.1.6 platform.

### **Networking Infrastructure at CSEA**

The LAN is distributed in 40 buildings in and around BBD Bag area using fibre optic cable, which is run along the side of the road and has crossed the road in certain points. Using dialup modem router connectivity has provided remote connectivity beyond 2 kms of the exchange in the city. For outside Kolkata, VSAT connectivity has been provided.

The networking infrastructure consists of the following:

- The dual fault tolerant 100 Mbps FDDI back bone comprising of 2 nos. 3Com 6000 series chassis based switches
- 8 nos. of 3Com 2500 edge switches and 2 nos. of Cabletron switches have been used to provide connectivity to broker premises from CSE over fibre optic and UTP cables
- Over 150 Bay and Synoptic hubs, which are connected to the edge switches, have been used to connect member PCs
- Structured cabling has been used all over the premises by racks, patch panels and outlet boxes
- VSAT connectivity is also there for out station members using 3Com router and Hughes equipment
- For connections in Kolkata beyond 2 kms, dialup modem router connectivity has been provided

#### **Network Architecture**

The entire network has been designed as fault tolerant. The backbone is based on FDDI dual ring, which ensures availability in the event of failure of a ring. Each of the members has been provided with 3 nos. of network connections at his office. Each of the point is from a separate hub and the hubs are connected from different switches. This ensures the availability of network at member's premise in the event of single hub or switch failure.

#### **Benefits to customer**

1. Brokers now know the best rates being offered for a scrip/trade before submitting an order.
2. Brokers can also compare the rates of a scrip in BSE, NSE or CSE
3. Filters are imposed to control trading, thus the rate of scrips could not be increased or decreased abnormally.
4. Volume of a trade for a single order can be controlled.
5. The member after submitting an order could immediately know if his/her order is valid and after a trade being executed he/she could get that information on the screen.
6. The opposite trader was unknown to the broker, thus secrecy of a trade was possible.
7. The member/broker now could trade to the extent allowed by his/her margin limit deposited with the exchange.
8. Two-sided quotes are available in the system.
9. Surveillance could now keep a hawk eye on the market thus control the scrip or trader if necessary. Surveillance can suspend / reactivate a scrip or a member online.
10. Trading time could now be increased or decreased depending on the requirement.
11. In case of exigency market can be halted and again reactivated during online trading by Surveillance.
12. Earnings of the exchange increased through margin and turnover tax.
13. Demat trading has resulted in the end of era of bad delivery.
14. Tracking of defaulters made easy.
15. Daily reports generated can easily be downloaded by the exchange or members.
16. System has successfully handled trading volume of Rs 3500 crores on a single day with satisfaction to user/broker community.