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# Supermontage as a New Trading System of NASDAQ

K.C. Tseng

## Abstract

Historically NASDAQ orders were sent directly to market makers for execution. The rules were changed to require that market makers' quotes reflect interests submitted by customers. Then the electronic communication networks came where brokers-dealers match customer orders directly with electronic access. In 1984 small order execution system was introduced to route small orders electronically for automatic execution. In 1990 NASDAQ introduced another electronic system known as SelectNet allowing brokers and dealers to deliver orders to one another and execute larger orders than SOES. In 2001 SelectNet and SOES were integrated into SuperSoes, which was further developed into SuperMontage. SuperMontage was launched in October 2002 and implemented in nine phases, and by December all NASDAQ stocks have been traded there. So far the new trading system has improved the execution speed and order fill rates and reduced locks and cross trades. With newly passed Regulation NMS, NASDAQ, NYSE, and ECNs will all be linked. The entire stock markets are expected to become more efficient and investors will benefit from the new trading system and new linkage.

## From Soes to Supersoes

SOES has been used by market participants to automatically execute orders against the best bids or asks or at the inside quotes. However, SOES orders must be agency orders, not proprietary orders. In addition, the maximum SOES orders are limited to tier size of 1000, 500, or 200 shares. SOES orders greater than tier size cannot be broken into multiple allowable orders. SOES cannot execute against ECN quotes or Unlisted Trading Privileges market makers. SOES is unique in that unpreferenced orders are routed to market makers based on price-time priority at the relevant inside quote. Since January 1997 only market and marketable limit orders have been able to enter into SOES (Smith, Selway, & McCormick).

During the 1987 market crash many small investors were unable to reach the market makers to execute their trades because market makers were not required to respond to orders received through SOES. In 1988 NASD made SOES participation mandatory for all market makers (Fan, Srinivasan, Stallaert, & Whinston). SOES was widely used by day traders who were referred to as SOES bandits. Many day traders use SOES to execute trades quickly and offset their positions through limit orders to be displayed in SelectNet or ECN.

Although SelectNet allows NASDAQ brokers and markets makers to negotiate buy and sell orders, it obligates market makers receiving SelectNet orders to execute them at their posted bids and offers. Basically there are two types of orders. One is a preference order which is used to route an order to a single market maker. The other is unpreferenced order which is broadcast to the entire market place. In a sense SelectNet is an ECN since it widely disseminates its limit orders. However the inside quotes of SelectNet broadcast orders are not included in SelectNet montage. Hence the ECN is not available for SelectNet broadcast orders. In the early years SelectNet was used primarily by day traders to broadcast orders. Since 1997 market makers increasingly have used preference orders. In August 1996 the SEC adopted its Order Handling Rules. The Limit Order Display Rule requires that customer limit orders which are better than the market makers' own quotes be reflected in the market makers' quotes, or otherwise the market makers must forward to an entity which will display the orders. The second rule is the Quote Rule which mandates that market makers cannot place one quote in NASDAQ and a different quote in an ECN unless that ECN makes its best price viewable and accessible to all NASDAQ market participants. The new OHR enhanced the rapid growth of preference SelectNet orders, which became the important link to ECN quotes. SelectNet orders became the primary tools for market makers to access orders greater than the SOES orders (Smith, Selway, & McCormick).

Introduced in July 2001 SuperSOES integrates key features of SelectNet and SOES and was intended to replace them eventually. The maximum share size for SuperSOES is 999,999. The 5 minute rule of SOES no longer applies. Large orders may split if necessary among available participants. If there are remaining shares to fill, SuperSOES will target the market makers. The 10 second cancellation rule no longer applies and market makers must continue to fill SuperSOES orders until their displayed amount and reserve size are depleted. All SuperSOES orders are executed on strict price-time priority or on a first come-first serve basis. If an ECN is a full participant, it is treated as a SuperSOES market maker. If an ECN is not a participant, the former SelectNet rules apply. SuperSOES cut the time span between hits to a market maker from 17 seconds to 0.5 to 0.8 second. In general, SuperSOES allows automatic execution, greater liquidity, and faster execution.

## Supermontage System

The descriptions of the SuperMontage system are taken from the proprietary information of the Nasdaq Stock Market, Inc. posted on the web. Under the various systems discussed previously, NASDAQ had collected pre-trade quotations at the single best bid and/or offer (BBO) for each quoting participant such as market maker, ECN, or Unlisted Trading Privileges (UTP) Exchange. The pools of liquidity existed below this "Top-of-File Pricing" were not available in the previous market systems. With the establishment of the NASDAQ Order Display Facility (ODF), Order Collector Facility (OCF) and Modifications of the NASDAQ Platform, SuperMontage displays the total amount of trading interests at the BBO and two levels above and below the BBO for a total of five price levels on the bid and offer sides of the market via the NASDAQ DepthView and disseminates this information via Aggregated Depth at Price (ADAP). Each price level is dynamically updated and the aggregate trading interest either attributable or non-attributable orders is shown. Market participants may indicate a reserve size for the quote/order, view the aggregated or decomposed attributable trading interest at the top five price levels or view the aggregate interest at all price levels.

If a market participant designates an order as "attributable", it is displayed in the montage next to the market participant's unique identifier (MPID). All attributable orders are displayed in the SuperMontage when the prices of the orders are within the best five price levels in NASDAQ. A non-attributable order does not display in the montage next to the market participant's MPID. All non-attributable orders at a particular price level are aggregated and displayed under a special anonymous MPID, "SIZE". For one SIZE MPID only the best priced non-attributable bid and offer orders will be shown in the system. However, all SIZE orders within the best five price levels are shown in SuperMontage as part of the DepthView aggregate trading interest. Market participants may indicate that a quote/order has a reserve size, which will replenish displayed size by at least one round lot or a pre-established larger amount. Reserve size is accessible via NASDAQ's trading platform, but it is displayed in the montage itself, NASDAQ Workstation Aggregate buttons, or in other data feeds products such as Depthview, PowerView, or TotalView. The DepthView shows the aggregate size of all quotes and orders at each of the top five price levels. The PowerView shows the best bid and ask price from each registered NASDAQ market participant and the aggregate size of all quotes and orders at each of the top five price levels in SuperMontage. The TotalView shows all quotes and orders at the top five price levels and aggregate anonymous interest at each of the top five price levels in the SuperMontage.

Market participants may give NASDAQ a single bid quote and offer quote, and no more than one proprietary quote on each side of the market. Market participants are allowed to provide detailed order information. SuperMontage requires market participants to indicate the order's capacity such as agency, principal, and no risk principal, and preferred execution algorithm. Market participants may choose to provide NASDAQ summary quote which allows them to maintain trading interest at multiple price levels. A summary quote must be designated as "Summary" at the time of entry.

Market participants may enter one of the following three types of orders: Non-directed, preferenced, and directed orders. An order may have a size up to 999,999 shares and must indicate whether it is a buy, sell, sell short, or sell short exempt. When a market participant enters an order

without identifying a specific party to which the order will be delivered or against which the order will be executed, the order is a non-directed order. A non-directed order may be a market order or a marketable limit order and is considered a liability order which is an order that a market participant is obligated to respond to under the SEC's Firm Quote Rule. A marketable non-directed order will be automatically executed against all participants who accept automatic executions. If an entering participant designates a specific party to which the order will be delivered or against which the order will be executed, it is a preferenced order. All preferenced orders are entered into the Non-Directed Order Process and are considered liability orders. A Directed Order is routed by the market participant entering the order to a specific MPID. Market participants enter a Directed Order into the SuperMontage via the Directed Order Process. Directed Orders are always delivered for response rather than to be automatically executed via the NASDAQ system.

Market participants have three algorithm options regarding how their orders interact with quotes/orders in NASDAQ: Price/Time, Price/Size/Time, or Price/Time with Access Fee Consideration. Except for internalization the default of SuperMontage is a strict price/time priority. But market participants can designate on their firm profile the preferred execution algorithm and all entered orders will be executed on the basis of the firm's preference. Firms can also indicate any alternative execution algorithm on order-by-order basis. SuperMontage examines the time priority of each order/quote increment, not the aggregate display of all order/quote increments of a participant at a particular price level.

When a market participant enters non-directed orders at the inside market, SuperMontage system will match the incoming order against its own inside quote/order instead of the participant next in the queue. Order-entry firms and non-quoting participants are excluded from this internalization option. Their non-directed orders may interact only with interest in strict price/time, price/size/time, or price/time with fee consideration sequence. Market participants have two options. First, they can indicate the intention to interact with their own quote/order. Second, they may not want to interact with their own quote/order by using the anti-internalization qualifier (AIQ) on order entry. The AIQ option is used when a market participant cannot trade as a principal with some particular orders such as orders from certain investment advisory accounts or ERISA type orders.

When an execution is delivered to a quoting market participant accepting automatic executions, SuperMontage automatically decrements the aggregate quote in the ODF and the participant's display quote/SIZE quote in the Montage by the delivered execution. NASDAQ will continue to deliver orders to such participant up to its displayed and reserve size until all sizes are exhausted. If the delivery participant declines or partially fills the order, NASDAQ will send the order or the remaining portion back to the system to the next available participant for immediate delivery or execution. Market participants can use the Automatic Quote Refresh (AQR) functionality to maintain the required two-side attributable quotes. When a market participant's principal attributable quote is exhausted to less than one round lot, the system will refresh its price and size by an increment and to the size designated by the participant. When a market participant uses AQR but has an attributable entry in the system, which is priced at or better than attributable quote/order created by the AQR, NASDAQ will display the better-priced attributable quote/order rather than the AQR-generated quote/order. When a market participant does not use AQR and has given NASDAQ multiple attributable quotes/orders, NASDAQ will display the participant's next best-priced attributable entry.

When the best bid and the best offer are equal, the market is considered as "locked". When the best bid is higher than the best offer, the market is "crossed". When a quoting market participant enters a quote/order that locks or crosses the market, it will receive a system warning as it was used to do. To complete the quote/order entry, the participant must override the system warning. When the market participant overrides the warning, SuperMontage will not display the order as part of the display quote, but the order will be treated as a marketable limit order and will be entered into SuperMontage as a non-directed liability order in time priority execution. In case of locked market, the orders are routed to the quoting market participant(s) next in queue that is locked, and the order is executed at the price of the locking quote/order. In case of crossed market, the crossing order is routed to some quoting market participant(s) next in queue and is executed at the displayed quote/order that has been crossed. After the lock-or-cross has been cleared, Super-

Montage will reformat the order and display it as part of a display quote if the quoting market participant's order is not completely filled. When the market moves up or down and the order is no longer locked or crossed, the system will either return the order or include it as part of a display quote in NASDAQ.

Since the implementation of SuperMontage NASDAQ has introduced a new opening process including a trade-or-move period during the pre-market, a lock-or-cross clearing, and followed by the normal market-opening processing. Starting at 7:30 a.m. Eastern Time prior to the market opening, market participants may submit proprietary quotes, summary quotes, market orders, and limit orders to SuperMontage. All market and lock-or-cross orders are queued until market open, while other day/good-till-cancel limit orders are reflected in the participants' display quote on the montage. At 9:20:00 a.m. ET NASDAQ begins trade-or-move period. At 9:29:30 a.m. ET NASDAQ starts to clear out any lock-or-cross market that has not been resolved during the trade or move period by executing the oldest most aggressively priced order/quote against the oldest most aggressively priced order/quote on the opposite side of the market. SuperMontage continues to clear the locked and/or crossed conditions until the market is no longer locked or crossed. All trades executed during the lock-cross clearing period and prior to market open are transmitted to the Automated Confirmation Transaction Service (ACT) as .T trades. Then the market is open at 9:30:00 a.m. ET to follow the normal execution process.

UTP Exchanges have received and are obligated to execute liability orders. They are required to take automatic executions against their quotes to participate in the SuperMontage trading system. They are able to enter and display their interest on a non-attributable basis in the SuperMontage. Their non-attibutable interests are represented by SIZE MPID and have the same priority as market makers and ECNs. Their attributable interests are displayed next to their MPIDs in the montage and can be accessed behind NASDAQ market makers and ECNs. The UTP Exchanges may opt not to participate in the SuperMontage.

In brief, SuperMontage allows market participants to enter unlimited quotes and orders at multiple price levels. Orders and quotes of all market participants are integrated and displayed on their front-ends and through data feeds. The system displays aggregate interest five price levels on each side of the market on a dynamic basis and other price levels on a non-dynamic basis. The basic features and benefits can be summarized as follows:

1. Access to SIZE for non-quoting participants: Market participant can use SIZE MPID to represent customer and proprietary orders in those stocks in which the firm is not a registered market maker allowing the firm to enhance competition and its choice of order flow.
2. Free internalization of orders: It is available but not required for quoting market participants if they are at the NASDAQ best bid and offer. This allows the initial match at the price against the firm's own orders.
3. Full anonymity: It is offered by SuperMontage's SIZE feature to make it possible for firms to minimize the market impact of large orders and simultaneously exposing the orders to large pool of marketable and non-marketable interests and liquidity.
4. Liquidity provider rebate: There is a rebate of $0.002 per share for liquidity providers. No trade-reporting fees for firms that execute more than 10,000 SuperMontage trades per day on average over a trading month.
5. Multiple market participant IDs (MPIDs): All participants may use two MPIDs in SIZE. Registered market makers and ECNs can use two attributable MPIDs. Firms can use MPID to separate order flow from different trading desks such as market making, institutional trading, arbitrage and program trading.
6. Order execution choice: SuperMontage lets market participants have three options to allow their orders to interact with quotes/orders in NASDAQ, i.e., price/time, price/size/time, and price /time with access fee consideration, which executes against access-fee charging participant last.
7. Order protection: Market participants and their customers are better protected from being traded through in the fast moving market by entering multiple quotes and orders in multiple prices.

8. Pegged orders: They allow market participants to automatically keep track of the NASDAQ inside so that orders continue to provide liquidity for market orders as the NASDAQ inside moves.
9. Reserve size: Market makers and ECNs can specify reserve size on their quotes and orders. Since reserve size is not displayed but can be executed any time, market participants may choose not to display their full orders.
10. Sweeping: One single order can access all displayed quotes/orders and reserve size through automatic execution. In other words, users of SuperMontage can access market participants at the inside market and beyond by sweeping.

## Preliminary Results on the Introduction of Supermontage

The results discussed in this section are taken from Results on the Introduction of NASDAQ's SuperMontage, prepared by NASDAQ Economic Research on February 4, 2003. This report focuses on four major areas: Execution quality, liquidity and quoting behavior, market share, and market quality. Clearly SuperMontage has increased the speed of execution and provided greater liquidity. SuperMontage orders were first executed in less than one-tenth of one second as compared to half a second for SuperSOES orders and more than one second for SelectNet orders. For full execution of large orders the new system is five to ten times faster than the previous systems. With the increased functionality market participants have increased their entry of reserve size. Consequently, both depth and liquidity have increased greatly. Market share increased about two percent during the first week of implementing the SuperMontage. However, market quality reflected by volatility and spreads remained about the same. In the following subsections, more detailed discussions will be presented.

### *Executions*

Time to first and full execution: It measures the time from when a marketable order arrives at the transaction system to when it is first executed. SuperMontage first execution is six times faster than SuperSOES and 18 times faster than SelectNet. SuperMontage auto-execution is 18 times faster than SuperSOES and SuperMontage order delivery is three times faster than SelectNet. SuperMontage auto-execution median time is only four-thousands of a second and is 40 times faster than SuperSOES. Since 30 seconds are allocated for ECN response to delivered orders to return to SuperMontage, the observed improvement in either the average or the median speeds of execution was slightly affected. SuperMontage full execution and largest orders have been executed faster than SuperSOES's smallest orders. In the old systems larger orders were required to use both SuperSOES and SelectNet to access liquidity across market makers and ECNs. However, SuperMontage can do multiple executions from a single platform without repeated quote refreshes. That is why SuperMontage is speedier and more efficient.

### *Improvement in Execution and Fill Rates*

The execution rate is the percent of orders at least partially filled. The fill rate is the percent of entered shares of the order executed. Under the old system multiple traders tried simultaneously to access liquidity on an ECN through SelectNet, and therefore not all orders would have been executed while some orders were rejected. SuperMontage sends only appropriate size to ECNs and simultaneously searches for additional sources of liquidity for the remaining orders. SuperMontage at least partially filled about 93 percent of all marketable orders compared to only 67 percent of SuperSOES and SelectNet orders. Most orders not executed were oversized relative to the quote or special handling instructions such as anti-internalization, preferenced to an ineligible or inaccessible participant. Some unexecuted orders violated short sale rules or cancelled in the process of delivery. SuperMontage executed about 60% of all marketable shares.

### *Quoting Behavior*

Before SuperMontage ECNs accounted for 68.5% of the average NASDAQ daily quotes followed by non-NASDAQ UTPs with 16.5% and market makers with 14.4%. After SuperMon-

tage, ECNs took care of only 44.9% since Instinet joined non-NASDAQ's UTP. Currently UTP includes Chicago, Cincinnati, American Stock Exchanges, and NASD's Alternative Display Facility. SuperMontage dominated all but the largest volume category in which the ADF had been very active.

***Quoting Depth***

Since SuperMontage allows market participants to submit multiple quotes and orders, they may enter their entire book into the montage. During the first week most firms continued to enter interest at just one price level. There were about 25 market makers, one ECN and one UTP submitted multiple levels for most of their stocks. Because order management systems had to be reprogrammed to enable automated routing orders to the SuperMontage book, some firms preferred to keep their order flow on their internal book. Other firms were slow to adjust the costly upgrading of computer and network systems to handle increased traffic to SuperMontage. The dollar depth of the book was calculated at fifteen-minute intervals for the top five price levels of each stock. The average depth of inside bid increased from $62,000 to $104,000, and most increases in depth came from the increased use of reserve size. Over time as more market makers submit orders at multiple price levels, depth is expected to increase greatly.

***Market Share***

Just before NASDAQ launched SuperMontage, AMEX started trading NASDAQ stocks, Island moved its quoting and trading to Cincinnati Stock Exchange, and Instinet left for NASD's ADF. These markets not linked to the central pool of liquidity might lock or cross and led them elsewhere to clear the locks and crosses. However, SuperMontage was able to increase market share that would have been lost in SuperSOES and SelectNet. During the first week the weighted market share of ECNs was down by 1.5%, but the market makers and UTPs had internalized a greater proportion of NASDAQ volume and so reduced NASDAQ and ECN executions. Under the fragmented markets the SuperMontage participants gained at the expense of non-participants. SuperMontage has operated more efficiently than SelectNet and SuperSOES. The new system has never internally locked or crossed, and it has never delayed by order delivery. The increased depth near the inside and the seamless executions will eventually increase the market share for NASDAQ.

***Spreads***

The average effective spreads remained at less than three cents across all stocks. The relative spreads adjusted by the rising stock prices declined slightly from 0.16% to 0.13% although the absolute spreads increased marginally. SuperMontage is expected to increase speed and liquidity, not the spreads.

***Volatility***

SuperMontage might reduce volatility by increasing depth at or near the inside market and by attracting additional liquidity. On the other hand, SuperMontage was a single-pipe transaction system allowing multiple orders to move quickly through different price levels, and so it might increase volatility. However, there was no evidence that SuperMontage had increased price volatility during the first week after the introduction of the new system. SuperMontage volatility and the market volatility had fluctuated in tandem.

***Locks and Crosses with UTP and ADF***

Locks and crosses cannot happen within the SuperMontage system itself. But they can happen in the entire marketplace because other markets such as UTP and ADF also trade NASDAQ stocks. Locks and crosses are the direct result of non-linked market centers that opt not to be represented in SuperMontage and not to route to the SuperMontage market center at the best available price. Non-NASDAQ market centers tend to trade more in the most active stocks and cause locks and crosses. During the first week about 38% of NASDAQ stocks had never experienced locks or crosses at all. In average the remaining stocks had experienced locks or crosses

only 1.2% of an average trading day and the lock/crosses episodes lasted for about one second before clearing.

## Potential Future Development

On November 22, 2004 the Wall Street Journal first disclosed a new trading-regulation proposal by SEC, which would require full list of offers and inter-market sweeps by brokers (Kelly & Solomon). The new proposal known as Regulation NMS was scheduled for a meeting to vote on December 15, 2004. At that meeting members decided to postpone the decision to a later date to solicit the public opinions and debates. The new rule requires better electronic linkages among all markets so that investors will get the best prices for most orders on both the New York Stock Exchange and the Nasdaq Stock Market so long as the orders can be filled automatically without human intervention. In addition, the new rule also requires that brokers sweep all markets including the interconnected NYSE, NASDAQ, and ECNs to fill an order at the best price.

Before SuperMontage brokers and market makers were required to enter only the best bid and offer for a stock into the public electronic database of stock quotes. The SuperMontage displays five price levels on each side of bid and offer for all participants entering quotes and orders. The proposed new rule requires that brokers and market makers enter all bids and offers for any stock into the electronic database. In addition, NASDAQ, NYSE, and ECNs will be interlinked. This will enable other brokers to sweep all markets to fill orders, including large block trades, at the best prices and simultaneously execute trades in the same stock across different markets. However, publishing the entire list of bids and offers in a given stock could be burdensome for brokers and the stock markets. In addition, the new rule may have some impact on John Thain's recently proposed market restructuring for NYSE to have a "hybrid" market where floor brokers with private order lists and traders with electronic means can coexist. He argues that Regulation NMS proposed by SEC is equivalent to transforming the U.S. market system into a virtual consolidated limit order book (CLOB). This CLOB will become a dynamic, diverse, and internationally competitive markets. In April 2005 the new Regulation NMS was passed by the 3-2 votes with SEC Chair William Donaldson casting the decisive vote.

## Conclusions And Further Research

Clearly SuperMontage is the result of continuous information technological break through and efforts made by Nasdaq market to improve its trading systems from the recent SOES, SelectNet, and SuperSOES. The SuperMontage has improved the speed of execution, order fills, quoting depth, liquidity, and locks and crosses. As information technology continues to advance, market participants want faster and better execution, investors want more complete information and better prices for their orders, and regulators have to accommodate the needs of market participants and investors, the trading system will continue to improve. It is vital for us to understand how the systems have evolved over time and the benefits from the newer systems. Furthermore, as information technology continues to progress rapidly, the potentially improved SuperMontage can be applied to other financial markets such as foreign exchange, options and futures and other derivative markets around the world. Many countries have the technological capability to implement some trading systems similar to SuperMontage to increase efficiency. There are plenty of opportunities for new researches in SuperMontage itself and other potential better systems to be developed in the future.

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