High Frequency Trading in the U.S. Equity Markets

By Glen Barrentine

Introduction

Since the publication of Flash Boys: A Wall Street Revolt by Michael Lewis in the spring of 2014, the topic of high frequency trading (“HFT”) in the U.S. equity markets has been much in the news while also receiving a great deal of attention from regulators, prosecutors and plaintiff class action attorneys. This attention has focused upon broad concerns, including fairness, the possibly negative impact of HFT on the equity markets, and whether HFT tactics are abusive, fraudulent or manipulative. Concerns have also been raised regarding whether brokerage firms that route a high percentage of their customer orders to capture trading-fee rebates, which orders may be more prone to interact with HFT firms, are meeting their best execution obligations to their customers. These concerns raise important issues that potentially affect all market participants. Importantly, they are also likely to trigger increased focus by regulators in examinations, lead to enforcement actions and may ultimately trigger significant changes in market structure and regulation.

In light of these concerns, it would be prudent for HFT trading firms and firms whose order flow may interact with HFT firms to better understand HFT and its possible impact and the regulatory issues created thereby. Firms should get ahead of potential regulatory issues by taking a proactive approach to these concerns.

Note that while HFT also exists in the futures and other financial markets, both in the U.S. and abroad, this article is focused on HFT in the U.S. equity markets.

This article begins with an overview of HFT, including a discussion of its size and other characteristics and how it is used. It then provides a brief overview of common strategies used in HFT. This is followed by a discussion of regulatory issues affecting HFT firms and rebate-seeking firms whose orders may interact with HFT firms, together with some steps that firms should consider from a compli-
High Frequency Trading – An Overview

As the U.S. Securities and Exchange Commission (“SEC”) pointed out in its Concept Release on Equity Market Structure (the “Equity Market Structure Concept Release”), there is no current definition of the term HFT. Because of this, the HFT label is often applied indiscriminately to activities that may share similar characteristics but may also be very different from one another. This lack of specificity makes it difficult to provide certainty with respect to basic facts about the HFT market.

Size of HFT. For example, the SEC’s Equity Market Structure Concept Release states that “[e]stimates of HFT volume in the equity markets vary widely, though they typically are 50% of total volume or higher.” The Concept Release then concluded “[b]y any measure, HFT is a dominant component of the current market structure and is likely to affect nearly all aspects of its performance.”

More recently, however, the Staff of the SEC’s Division of Trading and Markets, in its Equity Market Structure Literature Review, Part II: High Frequency Trading” at 5 (March 18, 2014) (the “SEC Staff HFT Literature Review”), highlight some of the issues surrounding estimates of the size of HFT volume in the equity markets and stated that “while HFT is clearly a large subset of algorithmic trading and computer-assisted trading . . . other types of automated trading are significant and may be quite difficult to distinguish from HFT . . . .” Based upon the SEC Staff HFT Literature Review, Mary Jo White, Chair of the SEC, has characterized “algorithmic traders,” as including HFT firms and a large percentage of institutional trading, and as “likely represent[ing] well over a majority of trading volume.”

Accordingly, it is difficult to know how dominant HFT may be. What we do know is that its dominance may be frequently exaggerated. In any event, questions as to the size of the HFT market are beside the point as HFT volume likely differs significantly based upon a number of factors, including the characteristics of the securities being traded, (e.g., large cap firms versus small cap firms, and of the underlying market place. For this reason, it makes more sense to speak about the dominance of HFT in relation to specific strategies and markets rather than to the market as a whole.

Characteristics of HFT Trading. While there may be no universally agreed upon definition of HFT, the SEC has identified the following five characteristics as ones that are frequently attributed to proprietary firms engaged in HFT:

- The use of extraordinary high-speed and sophisticated computer programs for generating, routing, and executing orders;
- Use of co-location services and individual data feeds offered by exchanges and others to minimize network and other types of latencies;
- Very short time-frames for establishing and liquidating positions;
- The submission of numerous orders that are cancelled shortly after submission; and
- Ending the trading day in as close to a flat position as possible (that is, not carrying significant, unhedged positions over-night).

Another way to think about the characteristics of HFT is to focus, first and foremost, upon its most prominent feature, namely speed. Simply put, HFT involves the generation of orders and their routing, execution or cancelation, over very short time frames. These time frames for order routing and execution are typically measured in milliseconds, that is, 1/100th of a second, or even microseconds, that is, 1/1000th of a second. To put this in perspective, a blink of an eye takes approximately 100 to 400 milliseconds or 0.1 to 0.4 seconds.

When times are measured in milliseconds or even microseconds, it is essential that every aspect of the order generation, routing and cancellation process be conducted at the highest speed, or lowest latency, that is reasonably possible. In order to examine the factors that go into achieving these high speeds, it can be helpful to break the overall process into three elements consisting of (i) data intake, (ii) data processing and order generation, which should be understood to include orders, cancels and other instructions affecting orders, and (iii) routing to effectuate the decision to generate an order or other instruction.

Data Intake. Data used in the generation of orders, cancellations and other order-related instructions consists of market data and non-market data. Market data consists of quotations and last trade updates. Non-market data consists of all data other than market data that may impact the market or the price of a particular security.
Market data comes in two flavors: consolidated and direct feeds. As the name implies, consolidated data feeds reflect the consolidated quotation or trade traffic from the entire market. Under Rules 601 and 602 of Regulation NMS, 17 C.F.R. 242.600 et seq., exchanges and other trading centers are required to send their best-priced quotations and trade reports to the applicable securities information processor or “SIP,” which consolidates that information with quote and trade traffic of other trading centers and distributes that information to subscribers.

Exchanges and other trading centers, however, are also permitted to distribute customized market data products directly to customers, provided that, in accordance with Rule 603(a) of Regulation NMS, such direct feeds are not released before the time the trading center sends its quote and trade reports for inclusion in the consolidated feed. It is important to stress, however, that while the exchanges and trading centers are prohibited from releasing the data that goes into the direct feed prior to the release of the data that goes into the consolidated feed, this requirement does not mean that the two feeds will necessarily be received by subscribers at the same time. Indeed, because the direct feed is sent directly to subscribers and does not have to pass first through the SIP, the direct feed generally will be received prior to the consolidated feed. Moreover, it is also generally the case that HFT firms can assemble the various direct feeds they receive from each of the markets to create, in effect, their own consolidated feed, in less time than it takes to receive the consolidated feed from the SIP.

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The latency of the SIPS, i.e., the amount of time it takes for a SIP to assemble the consolidated quote, is higher than that of the HFT firms for two reasons. One, the computers used by the HFT firms are likely to be faster than those used by the SIP in terms of processing the arriving data. Two, the HFT firms are likely to use a combination of co-location (explained in the paragraph below) and high speed connections between firms’ servers and those of the exchanges from which the data feeds are distributed with the result that the HFT firms will generally receive the direct feeds with less latency than the SIPS.

Co-location merely means that the HFT firm’s servers, that is the computers that it uses to receive and process data and make trading decisions, are co-located with, i.e., at the same location as, the servers used by an exchange to distribute market data and process trades. In substance, co-located means that the computers used by the HFT firms are closer to the exchange’s computer that releases the data than are the computers used by the SIPS. This means once released, the data has a shorter path to the HFT firm than it does to the SIP and, everything else being equal, it will therefore arrive at the HFT before it arrives at the SIP. Of course, receiving and assembling a consolidated quote still requires that the HFT firm be able to quickly route market information produced by one exchange to its servers that are co-located at other exchanges. For this purpose, HFT firms will use direct high speed fiber optics cables or even faster microwave relay towers to rapidly distribute information from one exchange location to its servers at other exchanges.

In his book Flash Boys: A Wall Street Revolt, Michael Lewis estimates that a HFT firm might be expected to view current, consolidated trade data up to 25 milliseconds before the time that a subscriber to the consolidated feed issued by the SIP would be able to view such data. While 25 milliseconds may not seem like a long time, in a world where trade decisions can be made and routed in microseconds, i.e., one-tenth of a millisecond, 25 milliseconds can be a very long time.

Lest it be thought that this latency advantage is anything truly new, consider that in the days when the New York Stock Exchange was, for all practical purposes, the market in NYSE-listed stocks, arguably the informational advantage enjoyed by specialist and floor brokers that operated from the floor of the NYSE was greater, perhaps much greater, than that provided to HFT firms by co-location. After all, floor participants could see and hear quote and trade activity before

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it was even *reported* to the SIP rather than, as now, before it is *received* by the SIP. Moreover, the SIP distribution times in those days were much slower than they are today, which means that this informational advantage persisted for a longer time. This time and place advantage was reflected in the costs of buying a membership on the exchange because exchange memberships were both limited in number and required as a condition to a firm being a specialist or floor broker. To give a sense of the value of being on the floor of the NYSE, between 1996 and 2004 the cost of an exchange membership, which entitled the owner or lessee to be on the floor of the exchange, fluctuated between $1 million and $2.65 million (prices are not adjusted for inflation). Likewise, co-location fees are similarly not cheap and can run into the tens of thousands of dollars a month. By way of example, a list of current co-location fees charged by the NYSE is available at [https://www.nyse.com/publicdocs/nyse/markets/nyse/NYSE_Price_List.pdf](https://www.nyse.com/publicdocs/nyse/markets/nyse/NYSE_Price_List.pdf).

As noted above, in addition to market data, HFT firms, like other investors and traders, may also consider a wide array of non-market data. Here too, HFT firms often have a time advantage over more typical investors resulting from the fact that market moving data may be made available to subscribers who are willing to pay extra for preferred access before such information is released generally. For example, Thompson Reuters/University of Michigan assembles and distributes a monthly consumer sentiment survey, which, upon release, can have a material impact upon the market. Previously, Thompson Reuters provided the survey to preferred subscribers two seconds before its scheduled release to the general public. Similarly, news services and other data providers have entered into arrangements that provide advance access to news headlines and/or stories to preferred providers. Indeed, even the SEC was found to be providing subscribers that paid for direct feeds with advance access to information before it was posted to the agency’s website.

Despite the fact that New York Attorney General Eric Schneiderman has labeled this practice “Insider Trading 2.0” and has badgered at least Thompson Reuters to desist from providing market moving information at different times to different subscribers, there is nothing illegal about such practice. From the perspective of insider trading, the selective distribution of information only becomes problematic where the dissemination of the information breaches a fiduciary duty or duty of trust or confidence. In the absence of these factors, limited or even exclusive dissemination of information, even market moving information, is not illegal. Similarly, trading while in possession of such information would not constitute insider trading because the owner of the information is not breaching any duty owed to another. Indeed, traders and investors have always invested resources in obtaining informational advantages over other traders and the public at large.

*Data Processing and Order Generation.* Of course, information by itself does not generate orders. Rather, information must be evaluated before a decision can be made as to whether to take any action in the market. In light of their need for extreme speed, HFT firms employ sophisticated computer programs or algorithms that operate from co-located servers. These algorithms are designed to process new information as it arrives and rapidly make decisions as to whether any action should be taken in response. The ability to rapidly process information and use it to make trading decisions also contributes to the time-based informational advantage enjoyed by HFT firms. That is, even as to information that is disseminated broadly such that the HFT firms receive the information at the same time as everyone else, HFT firms will still have an information advantage based upon their ability to process the information rapidly and reflect it in their trading decisions.

It is these algorithms that process information and make trading decisions that separate one HFT firm from another and that are largely responsible for a HFT firm’s success or failure. After all, anyone with the money to do so can invest in the fastest computers and direct feeds and other information sources and co-locate their servers at the exchanges. Algorithms used by HFT firms, however, are proprietary.
and generally developed in-house and can set one HFT firm apart from another in terms of the strategy pursued, its speed of execution, or both. Algorithms are jealously guarded and protected by firms as shown by several recent legal cases where firms have accused programmers of having stolen computer code. Indeed one such case is detailed by Michael Lewis in Flash Boys.

Routing. The final stage in high frequency trading is the routing of the instruction to the exchange. Like the stage before it, this stage depends both upon sophisticated programs that control routing decisions and the speed of the equipment used to effectuate those decisions.

High Frequency Trading – How is it Used?

Now that we have a general idea of the characteristics of HFT, it is necessary to understand how it is used. Unfortunately, that question is easier posed than answered. HFT can be used in connection with a broad range of trading strategies. Moreover, as the SEC stated in the Equity Market Structure Concept Release, many of the strategies used by HFT firms are not new. That is, the technology used by HFT allows for improved execution but is not fundamentally different from what traders have always done. On the other hand, some strategies would not exist but for the capabilities offered by HFT.

While a general overview of strategies used by HFT is necessarily beyond the scope of this article, the strategies described in Flash Boys include the following.

Electronic Front Running. Electronic front running is a term used by Michael Lewis to refer to a HFT firm that is able to identify that an institutional investor, e.g., a pension plan or mutual fund, is “working” a large order by sending multiple orders across multiple exchanges over the course of an extended period of time. By way of example, assume Institution A wants to buy 10,000 shares of XYZ and as an initial purchase sends orders for 100 shares of XYZ to 8 different exchanges. Due to the latency between XYZ (or its routing broker) and the different markets, these orders will arrive at the markets at slightly different times. The first order is executed at Market A at $20.01. Due to its co-located servers at Exchange A and its subscription to a direct feed from Exchange A, the HFT firm is able to react to this execution before the market place generally. The HFT firm then uses its high speed routing networks to buy shares of XYZ at $20.01 in the other markets ahead of Institution A, whose orders may be slower to arrive at those markets, and then sell these shares to Institution A at $20.02, making a profit of a penny per share.

Arbitrage. An arbitrage strategy seeks to capture pricing differences between related, that is, convertible, products, e.g., ETFs and the underlying basket of stocks that make up the ETF. Arbitrage can also capture pricing differences in the same security as priced on different markets. Significantly, the existence of price differences in the same security depend upon the fact that, in the U.S., under SEC Regulation NMS, 17 C.F.R. 242.600 et seq., equity securities can be traded simultaneously on many different venues, including multiple exchanges and so-called dark pools, i.e., an alternate trading system regulated under SEC Regulation ATS, 17 C.F.R. 242.300 et seq., that does not publicly display quotations in the consolidated quotation data. Moreover, Rule 611 of Regulation NMS prohibits trading through, that is, trading at a price that is inferior to, the best quotes on each automated market.

In Flash Boys, Michael Lewis describes a HFT trading strategy that he calls “slow market arbitrage,” which is also referred to as “latency arbitrage.” By way of example, assume that common stock of XYZ is trading at $20.00 by $20.01 on multiple exchanges, i.e., that the best quote in the national market is $20.00 by $20.01. Assume that there is a large buy of XYZ on Exchange A. This buy triggers a shift in the bid/ask on Exchange A to $20.03 by $20.04. Before either the buy or the quote change on Exchange A is reported in the consolidated quote, it is assumed that HFT firms would use their superior speed to attempt to buy the remaining XYZ shares available on other markets at $20.01 and then sell the shares at the $20.03 bid on Exchange A.

Because the quote change on Exchange A causes the bid on Exchange A to “cross” the ask quoted in the remaining exchanges, that is, the bid on Exchange A is higher than the ask in the national market, that quote would violate the prohibition contained in Rule 610(d) of Regulation NMS against quotes that cross the best bid or offer in the national market. The primary exception to this general rule is where the order that triggers the cross is an intermarket sweep order (an “ISO”) and simultaneous orders are routed to all other markets that have a price that is equal to the display price, i.e., those protected quotations that would be “locked” by the
displayed quotation, as well as all quotations with prices that are better than the display price, \textit{i.e.}, those protected quotations that would be “crossed” by the displayed quotation.

While Michael Lewis characterizes slow market arbitrage as predatory, arguably this practice promotes efficiency in the markets and, therefore, is beneficial. Indeed, the SEC in its Equity Market Structure Concept Release took no position on whether this strategy was beneficial or harmful but rather asked for comment on whether it was “beneficial for long-term investors and market structure quality?” It should also be considered that slow market arbitrage is not without risk as, in the foregoing example, the purchase at 20.01 might only be profitable if the sale at 20.03 is available, which fact cannot be guaranteed no matter how fast the HFT firm might be.

Strategies Outlined in the SEC’s Equity Market Structure Concept Release. The SEC’s Equity Market Structure Concept Release identifies four broad types of strategies used by “proprietary firms,” by which the SEC means “professional traders acting in a proprietary capacity that engage in strategies that generate a large number of trades on a daily basis.” The concept release labels these four broad types of strategies: (i) passive market making; (ii) arbitrage, which was discussed above; (iii) structural; and (iv) directional.

Passive market making is nothing more than buying at the bid and selling at the offer and making money on the spread and/or any liquidity rebates offered by the trading center. This is traditionally what specialists and market makers have always done. HFT firms that engage in passive market making differ from traditional specialists and market makers primarily in the speed with which they move their quotes and the fact that they are likely to layer the book with multiple bids and offers at different prices and sizes.

By “structural” the SEC means the exploitation of structural vulnerabilities in the market or a market participant. For example, a structural strategy includes the ability discussed above to exploit informational advantages and trade before market moving information has been processed by other participants.

By “directional” the SEC means short term strategies that are based on an anticipation of an intra-day price movement in a particular direction. This term does not include prohibited strategies, such as front running, that depended upon the use of information in violation of a duty to a customer or other party. As stated in the SEC’s Equity Concept Re-

Whether HFT is Good or Bad for the Marketplace and Other Investors

It is difficult to speak in general terms about whether HFT is good or bad for the marketplace or for other investors without focusing on specific strategies, specific securities types, \textit{e.g.}, large cap versus small cap, or even specific investor types, \textit{e.g.}, retail versus institution. Indeed, even then, there seems to be little consensus over whether particular HFT strategies provide efficiency and additional liquidity to the marketplace, a good thing, or whether the liquidity it provides is illusionary, that is not there when it is actually needed, at the cost of a slightly inferior execution for other investors. A good overview of the professional papers that have looked at these issues can be found in the SEC Staff HFT Literature Review.

Regulatory Issues

\textit{Risk Management and Financial and Operational Controls.} Since the so-called “flash crash” in May 2010, when the U.S. equity
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Markets experienced what the SEC and CFTC in a joint report characterized as “an extraordinarily rapid decline and recovery,” the regulators have been concerned about the possibly negative impact on the marketplace of technology generally and high speed trading in particular.7 These concerns have only been exacerbated by more recent problems affecting both exchanges and market participants.8 Not surprisingly, supervision and governance surrounding trading technology is also listed as an exam priority in the FINRA 2015 Exam Priorities Letter.

Manipulative and Fraudulent Conduct. HFT, like any other trading methodology, can be used improperly to engage in manipulative or fraudulent conduct in violation of the securities laws. One such strategy that often, though not necessarily, employs HFT that has caught the attention of regulators is called “layering” or “spoofing.” Layering or spoofing occur when a trader uses so-called non-bona fide orders, that is orders that the trader does not intend to be executed, to induce others to buy or sell a security at a price that is not representative of actual supply and demand. Layering and spoofing are described in several enforcement cases brought by both the SEC and the Commodities Futures Trading Commission.9

Recent Actions By FINRA. FINRA’s Annual Regulatory and Examinations Priority Letter for 2015 (the “FINRA 2015 Exam Priorities Letter”) identifies “abusive trading algorithms and deficient supervision for potential manipulation as among the most significant risks to the integrity of the markets.”10 Significantly, FINRA identified “abusive trading algorithms” and not HFT. FINRA also specifically stated that it will “review whether firms’ supervisory and other controls failed to appropriately detect abusive activity by the firm’s traders or its customers.” FINRA also cautions firms to look for cross-market and cross-product manipulation.

FINRA has also requested comment on a proposal to require registration of associated persons involved in the design, development or significant modification of algorithmic trading strategies.11 In its notice, FINRA stated that “robust supervisory procedures, both prior to and after deployment of an algorithmic trading strategy is a key component against protecting against problematic behavior stemming from algorithmic trading.”12

More recently, FINRA issued guidance on supervision and control practices for algorithmic trading strategies.13 FINRA’s guidance focuses broadly on each stage in the life cycle of an algorithm consisting of development; testing; and production (trading). FINRA recommends that firms ensure that there is “effective communication” between compliance staff and staff responsible for algorithmic strategy development. FINRA also recommends that firms consider using a “cross-disciplinary committee” to assess and react to the evolving risks associated with algorithmic strategies and that this committee include representatives of support and control functions. Firms that are active users of algorithmic trading strategies should review FINRA’s guidance carefully.

Recommendations reflecting, but not limited to, FINRA’s guidance are set forth Table 1 on the following page.
Table 1.

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<th>Recommended Compliance Steps for Firms that Engage in Algorithmic, Technologically Driven Trading</th>
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<td>Compliance should oversee the adoption of a robust program to monitor the development, testing and implementation of quantitative trading strategies for purposes of risk and compliance</td>
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<td>Such a program should include a focus on:</td>
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<td>Incident response procedures</td>
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<td>Books and records</td>
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<td>Other considerations</td>
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*Order Routing Practices and Best Execution.* As discussed in Michael Lewis’s book, trading centers may pay trading fee rebates to brokerage firms for routing their customer orders to the trading center. In its Exam Priorities Letter for 2015, FINRA highlighted a concern that such practice may result in firms receiving “inferior executions of their customers’ unmarketable limit orders because of market movements during the pendency of the orders.” FINRA also announced that it had initiated a sweep of firms that route a significant percentage of their unmarketable orders to rebate paying market venues.
While the sweep is still ongoing, FINRA has found that some firms do not have active best execution committees or other supervisory structures to meet their obligation to regularly and rigorously evaluate the quantity of customer order executions.

**Conclusion**

While there is no universally agreed upon definition of HFT, the term is generally applied to trading methodologies that rely on high speed computers and low latency communication networks to process data and transmit orders and trading instructions. Notwithstanding certain common characteristics, HFT firms may exhibit a broad range of strategies that may have little in common. Accordingly, it is difficult to characterize HFT in any meaningful way without taking into account a particular strategy.

Algorithmic, technologically driven trading does, however, raise a number of regulatory concerns. Firms that engage in such trading should adopt a robust program to monitor the development and implementation of quantitative trading strategies for purposes of risk and compliance.

Orders routed to rebate paying venues may be more prone to interact with HFT firms. FINRA has raised concerns whether such routing practices may result in inferior execution of non-marketable, customer limit orders because of market movements during the pendency of the order. Firms that engage in such routing practices should rigorously evaluate their best execution review, including whether such review adequately takes into account the impact of market movements on resting customer orders.

ENDNOTES

6 Glen Barrentine is a partner in Winston & Strawn’s New York office, and is chair of the firm’s broker dealer regulatory practice. Mr. Barrentine’s practice focuses broadly on regulatory, compliance, and enforcement matters affecting broker-dealers, investment advisers, exchanges and other marketplaces, as well as CFTC regulated entities such as swap dealers, IBs, FCMs, CPOs, and CTAs. He frequently represents clients in connection with enforcement proceedings and internal investigations and advises on inspections, examinations, and other regulatory inquiries. Mr. Barrentine also advises clients on the full range of regulatory and compliance issues that may arise under the Federal securities and commodities laws and the rules of FINRA, NFA and the other self-regulatory organizations. Substantive areas of advice include insider trading, registration and membership issues, anti-money laundering, capital requirements, sales practices, research, trading and trade reporting, distribution of securities, pay to play restrictions, supervision, and soft dollars.


5 See the chart of membership prices published by the NYSE at http://www1.nyse.com/pdfs/seatsale.pdf.

6 For a more detailed discussion of momentum ignition see the discussion by Themis Trading LLC at http://blog.themistrading.com/exploratory-trading-and-momentum-ignition/.

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See, e.g., the SEC’s action against The NASDAQ Stock Market in connection with its listing of shares in Facebook, Inc. (available at http://www.sec.gov/litigation/admin/2013/34-69655.pdf), and Knight Capital Americas LLC, which lost over $460 million over a 45 minute period due to an error in the operation of its automated routing system for equity orders (available at http://www.sec.gov/litigation/admin/2013/34-70694.pdf).


See FINRA Regulatory Notice 15-06.

Id.


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