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Focusing on Frequency

High-frequency trading strategies have, in a relatively short space of time, become an integral part of large numbers of buy- and sell-side firms' trading operations. And for good reason – they allow financial organizations to automatically execute large numbers of mostly low-value trades, freeing up valuable resources to focus on other trading-related activities

Q Waters: What role do data centers play in high-frequency trading (HFT)? How can chief information officers (CIOs) ensure that traders will have access to the computing power and market and historical data to make the best executions each time?

Varghese Thomas, global head of financial services, Savvis:

Most people associate the role of the data center in HFT as providing the space, power, cooling and network connectivity for trading firms' IT infrastructure – that is, co-location, and that's of course available for those firms that want to manage it all themselves.

Savvis, however, differentiates itself in a number of ways.

First, in the breadth of execution venues and other service providers located in our premier proximity hosting centers. These "trading ecosystems" bring together liquidity points, content, services, and IT infrastructure to enable successful execution of the entire trading life cycle. This allows trading firms to shift the burden of technology acquisition, maintenance, and management over to specialists, while supporting critical pre-trade, trade execution, and post-trade activities so they can focus on their core businesses.

Second is our collaboration with Thomson Reuters, which combines Savvis' hosting facilities and market connectivity with Thomson Reuters Enterprise solution suite. The solution enables

managed services – compute, network, managed security, back-up and storage solutions, etc – allowing trading firms to simplify and streamline IT management throughout their organization, by providing the flexibility to expand and contract their infrastructure as business needs dictate. As a technology-neutral provider, we enable firms to exploit new technologies and platforms very quickly and cost effectively.

These capabilities provide HFT firms with a flexible and efficient tool box with which to build and back test models, enter new markets and focus on the business of generating alpha.

Scott Caudell, senior vice president global architecture, Interactive Data:

I see data centers as a very important factor to a trading business, whether a trading firm is high frequency or not. Data centers play a key role in security, reliability, scalability, and performance. CIOs can aid high-frequency trading with appropriate access to computing power and data by having best-in-class security and monitoring capabilities. Trading firms also need to create testing and research environments to keep pace with the myriad new vendors, products, and enhancements in order to ensure that they have competitive and high-performance execution capabilities. CIOs can give traders access to these services – high-performance execution and monitoring capabilities – by finding managed solutions providers that focus on the HFT market. In the end, it will be the sum of all the infrastructure parts that creates best execution with telecommunications, hardware, and software components.

Ken Barnes, general manager, secure financial transaction infrastructure and co-location, Americas, NYSE Technologies:

Data centers are essentially the catalyst for effective markets, where value-adding liquidity providers and risk managers can operate in a secure, resilient, and transparent manner. Modern data centers provide a range of connectivity options to counterparties and service providers in and out of the facility to access the data and computing elements required to run their businesses. NYSE Technologies, for example, provides a range of connectivity services to our customers that range from sophisticated high-capacity direct market connectivity to economical solutions for connectivity across multiple venues and trading partners. Ultimately, CIOs need to assess their application portfolios and match them with the right mix of performance and cost.

Andrew Actman, chief strategy officer, Lightspeed Financial, Inc:

Data centers play an important role in high-frequency trading, not only in minimizing latency by providing close proximity to market venues, but also by providing a secure environment for an HFT firm's executions. By co-locating at a data center,



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firms to plug their trading applications into a single architecture designed to lower total cost of ownership, streamline deployment and improve time to market with a single point of access to global trading venues. This global infrastructure provides firms with access to low-latency and consolidated market data, software and analytics, and a data management and distribution platform, together with the ability to have their infrastructure, low-latency data feeds and applications hosted and managed within these centers.

Third, in addition to basic co-location, Savvis offers a suite of

which provides the ability for traders to connect with all the desired exchanges, firms can help ensure that their clients have the ability to get the best executions possible.

Jeffrey Wecker, president and CEO, Lime Brokerage:

As the need for speed increases across a broader array of trading strategies, data centers are playing an increasingly important role. Computer-assisted trading models need to react to fleeting opportunity windows that may last mere microseconds, opportunities that would never materialize if data-generated signals couldn't set the appropriate pace. Traditional liquidity-providing HFT strategies such as virtual market-making have always relied on speed to stay ahead of the queue, but now speed is also a requirement for other traditionally less latency-sensitive strategies, such as statistical arbitrage, exchange-traded fund arbitrage, algorithmic trading and options trading. Even with full pre-order risk controls, which are already available and will undoubtedly gain more traction due to impending SEC rulings, the entire process relies on high-speed data to function effectively. While broad and deep data sources delivered via aggregators are yesterday's standard, the new paradigm is about

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direct-from-venue ultra-low latency data and per symbol/security subscription capabilities delivered in a normalized format. HFT traders have very specific strategies and in most cases don't require data on the full universe of securities to operate effectively. Direct normalized feeds will provide the necessary speed to compete in today's HFT market-place, help optimize throughput/bandwidth and ultimately minimize costs. Historical data can be delivered from these as well as from more traditional sources, which are not as time-sensitive.

Michael Levas, founder and CIO, Olympian Capital

Management: Obviously data centers play a very integral part, and also the networking. What these data centers are using for networking is I think an especially important part of this. That speed and that ability need to be supported. As far as the CIO's assuring that the traders have access, that's a matter of just making



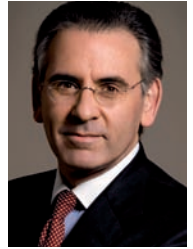
Andrew Actman,
Lightspeed
Financial

sure that your technology is the best technology that's out there. If you can afford it, obviously that's going to help you immensely.

Eric Pritchett, CEO, PhaseCapital: Data centers play a critical role in high-frequency trading primarily because they are more robust for production trading activities than the office buildings that typically house the traders themselves. In addition, the opportunity to cross-connect or co-locate services within data centers that house the actual exchanges and alternative trading systems makes

high-frequency trading practical for firms that otherwise might be unable to establish peer-to-peer arrangements with the market venues themselves. Clearly, being "closest to the matching engine" at the physical layer provides an advantage, although in our opinion that advantage is negligible compared with other considerations, such as lower-level data handling in the operating system kernel and expected variation in performance at the transport layer.

It is easy to lose an advantage at the physical layer through mistakes and missed opportunities at higher layers in the protocol stack. Ultimately, these "tech" issues are really the subtext and not the headline when it comes to thinking about how much latency is "too much" for any particular algorithm. The headline is the rapid and nimble implementation of appropriate business and risk management logic in any trading strategy. While less latency is generally better for any high-frequency trader, the devil is usually in the details of getting the trade-offs right when deliberately introducing latency by implementing logic that ensures quality from data ingestion through decision-making and actual execution.



Jeffrey Wecker,
Lime Brokerage

Q Waters: Are proximity and co-location the most critical factors in shaving milliseconds for firms?

Caudell: It depends on the trading strategy but I believe that, often, proximity to a matching engine can be a key factor to success. Other key factors include market data quality, and software and hardware components of the trading infrastructure.

Barnes: Co-location can be the most critical factor in shaving milliseconds for firms. At this point, anyone serious about competing in the market will find little room in the software layer of infrastructure to reduce any more latency at the millisecond scale – something co-location can offer. A more important factor is simply having transparency versus one's competitors. Try as you might to optimize the performance of one's own trading stack, the fact that in most co-location sites your competitors might be leveraging a better network than yours can put you at a competitive disadvantage and undermine those efforts.

Thomas: While there are a number of "components" – co-location, server and network infrastructure, software, etc – that make up HFT solutions, it's generally agreed that locating your trading systems as physically close as possible to the execution venue is critical to, and a significant contributor in, reducing latency. The fact that exchanges themselves are now offering co-location facilities highlights the market demand for this capability. In addition, visibility into latency causes is critical, since there are various components that can induce delay anywhere within the execution venue, networking and/or trading application.

Actman: Proximity and co-location are integral to low-latency executions. However, they are only components of the process. A stable platform is also essential to implementing a successful HFT strategy. Additionally, as important as co-location is moving to a 10-gigabyte switching infrastructure. These two approaches will present quantum leaps in speed and are the starting point for high-frequency trading.

Wecker: Physical proximity is clearly an important factor in overall to-market latency. However, latencies introduced by sub-optimal networking equipment and trading applications in many cases erase any of the benefits of co-location. Internal networks optimized for latency and carefully crafted applications may have a greater effect on latency than just moving servers from point A to point B.

Levas: No, I don't believe that. If you're in the US and you're running a highly powerful technology platform, that won't be an issue. If you're overseas in some remote place and/or you have some connectivity or networking issues, those will definitely have an



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effect. But if you're on the east coast and you're able to deal during regular market hours, then I don't think this will be an issue.

Pritchett: No. While co-location is considered a "cost of doing business" for high-frequency trade execution, it is really the starting point of the latency game and not the end point. The technologies that drive end-to-end systems with extremely low latency are relatively well known and relatively accessible to those wishing to deploy them in the context of the co-location. Particularly with what we see in the new market access rule and from the NYSE as related to the Mahwah deployment, regulators and exchanges alike are becoming more sensitive to concerns that just being "closest" is enough to get a real execution advantage. In reality, it takes much more to gain a sustainable latency-based execution advantage and the biggest issue, again, is making the right set of trade-offs between pure speed and business logic, especially pertaining to risk management.

Q Waters: What role will CEP and/or other value-added applications/services play in an effective HFT strategy?

Bruce Boytim, vice president, managed transaction services, NYSE Technologies: The complex event processing (CEP) engine plays a critical role in deploying an effective HFT strategy. In fact, many HFT firms will develop their own systems to meet their strict criteria. This is basically the mechanism that will tell firms if particular strategies will work or not – and HFTs can make mission-critical decisions based on the outcome. A specific value-added service that can help HFTs hone in on alpha-seeking strategies are hosted market data applications and tick data. This type of data helps traders gain insight into market anomalies that they can use to their advantage.

Thomas: As the regulatory environment continues to change, it will be imperative for HFT firms to ensure proper risk management

and best-execution capabilities are in effect. Lots of firms integrate machine-readable news feeds and sentiment engines into their applications. CEP, hardware acceleration, etc. are also very common. In addition to the proprietary applications HFT firms have designed and built themselves, it's highly likely they will also leverage applications and data services from a range of liquidity venues and third-party vendors. A key value proposition of Savvis' Proximity Hosting is access to a trading ecosystem of market participants and systems and applications providers, making it easier to connect to and integrate with these services. With fragmented markets and the search for best execution, HFTs can leverage low-latency connectivity and smart order routing to a multiple number of execution venues to deliver a holistic view of the market.

Caudell: CEP vendors are certainly not a silver bullet for electronic trading, but they will continue to play a valuable role in the market. CEP vendors provide trading firms with the ability to rapidly develop trading strategies and bring them to market. Historically, they played a key role in executing complex trading strategies and now we are seeing more CEP vendors evolving to support pure speed-based arbitrage strategies.

Actman: While Lightspeed does not currently employ CEP, we are always evaluating ways to improve our performance, our throughput and our product.

Wecker: As CEP continues to evolve, it is playing an increasingly significant role in facilitating new and effective HFT strategies. As the markets become even faster and more complex, CEP is especially critical in detecting patterns that help traders achieve alpha and/or limit their risk. Some of our customers are using integrated solutions incorporating CEP from leading vendors with our high-speed data and execution capabilities for an increasing array of uses including algorithmic trading, smart order routing, market data management, options, foreign exchange and risk applications. CEP providers are being challenged to provide a utility box of calculation permutations and to speedily make trading and risk decisions. The flexibility gained by having a tool box of efficient programs in a CEP must not induce any more latency than a traditional calculation written in Matlab (Java, C++). The challenge is for speed to market to not be impeded by additional latency.

Pritchett: While "effective HFT strategies" can be deployed with or without CEP, CEP is a critical enabler of excellent latency performance outside the context of managing latency. Specifically, CEP allows firms to build critical business logic such as data cleansing and order management rapidly without introducing substantial latency as a result. Choosing to deploy CEP at a high-frequency trading firm should be more about what the firm wants to spend the bulk of its time doing versus deciding whether it is the best or only way to address latency in the trading system. For example, at PhaseCapital we prefer to spend time devising strategies to interpret Level II market data rather than hacking kernels to shave microseconds from our execution responsiveness. To some extent, we are in the low-latency game whether we like it or not by virtue of being a high-frequency trading firm, although the latency



Michael Levas,
 Olympian Capital
 Management

that matters most is still the time between having a great idea and deploying it as part of our live trading process.

Q Waters: What effect will the proposed “Volcker rules” on proprietary trading have on high-frequency trading? On the regulatory front, is Europe ahead of the US, and what else can we expect here in the US?

Caudell: The proposed rules would, in part, prohibit certain banking institutions from having an internal proprietary trading group. In our experience, when the economy contracted, we saw a number of banks reduce the number of specific trading desks or internal proprietary groups. In several cases, we saw proprietary traders leave and start their own firms.

Actman: I would first say that not all firms that employ a proprietary trading model utilize high-frequency trading strategies and these firms could potentially spin out into new, separate entities if they employ a high-frequency trading strategy. While it is too early to tell, overall I don’t expect it to have too significant an impact on high-frequency trading. On the regulatory front, Europe and the US have taken different approaches and in the US, we are still waiting for the proposed regulation outlined in the Securities and Exchange Commission (SEC) concept release to be implemented in order to see what effect these changes will have on the market. Whether in Europe or the US, we all understand what the hot button topics are, and trust that the SEC is taking the right approach.

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As the equities, forex, and futures markets further mature, I see more cross-asset trading strategies being developed

Scott Caudell, Interactive Data

Wecker: It’s a bit premature to comment on the precise effect the proposed rule would have on high-frequency trading specifically, especially in light of other regulations potentially affecting the markets, which are currently being discussed. The proposed Volcker rules are designed to prevent proprietary trading at “too big to fail” banks. HFT in general is not capital-intensive and therefore does not require a large balance sheet for implementation. Hence, if our country were to pass a Volcker rule, the trading would move offshore or, alternatively, these teams would spin out of the big banks and set up shop on their own.

Boytin: We don’t believe there will be real material change if the Volcker rules take effect. The profits in trading are simply too high and banks will likely find a way to engage in an activity that yields similar results. The profits in trading are simply too high and might be necessary in some instances to ensure liquidity.

Levas: The Volcker rule is obviously going to have some effect on proprietary trading at banks. This is a slight return to Glass-Steagall, and it will have the effect that Volcker is intending. He’s trying to bring back some sense that the banks are not just trading their money but lending their money. Are funds going to have to hedge and cover their accounts? Absolutely. There’s going to be some kind of

meeting halfway. If you have firms like Morgan Stanley and retail brokers out there, you need inventory and you need to be able to hedge that. The effect will be either that Morgan Stanley loses its bank charter and goes back to the way it used to be, or it will be able to meet some halfway point where it is able to implement some type of hedge. Maybe not trading various indexes and/or going short just for the purpose of making money, but I think this will move in that direction. If it’s an investment firm without a bank charter, there’s no issue. They can do anything they want, and rightfully so. Is Europe ahead of the US in terms of regulation? No, Europe is far behind the US. They’re looking to us to gain some insight into what we’re doing and how we’re doing it.



Eric Pritchett,
PhaseCapital

Q Waters: What new asset classes do you see HFT moving into over the coming year? What challenges does each asset class bring when working with HFT?

Thomas: Traditionally, HFT has focused on equities, with subsequent moves into derivatives (futures and options) and foreign exchange. More recently, fixed income has come into scope as matching engines and connectivity proliferate.

Caudell: I believe we’re going to see more HFT in the equity options and over-the-counter markets. As the equities, forex, and futures markets further mature, I see more cross-asset trading strategies being developed. The challenge will continue to be managing the complexity of the infrastructure and the ever-increasing volumes of market data.

Actman: We see a more aggressive movement towards options and futures, as well as international markets, all of which are under way today in some capacity. Some of the challenges potentially faced by high-frequency traders include the availability of co-location facilities, clearing components, implementation of overall risk management, as well as finding the right telecommunications carrier with the best infrastructure to support this type of activity.

Wecker: Clearly, options, currencies and also futures are gaining the most traction due to their inherent liquidity, potential for arbitrage opportunities, and the increasingly global nature of HFT trading.

Both valuation and the dynamics of each asset class have a dramatic impact on how each type of security trades. As such, there are many nuances in each asset class that create a natural barrier to entry for a high-frequency trader. Capital requirements, exchange membership obligations, auction process, role of and rules for market-makers, availability of real-time market data, and clearing and settlement procedures are just some of the challenges facing a trader prior to implementing his strategy in a new asset class.

Boytin: In the next year, you will likely see HFTs grow into the options and forex trading worlds. There are more arbitrage opportunities available in these worlds that HFTs utilize to obtain effective results. In addition, options markets are leveraging data centers more and bringing the options markets closer to the point of execution – ideal for high-frequency players. In the forex world, high-frequency traders are becoming more opportunistic and not solely using hedging strategies anymore. As far as challenges go, the

amount of market data being delivered to this market is 10 times that of equities market, the market structure is extremely fragmented, and the payment structure of being paid on order flow will be the major obstacles HFT firms need to overcome to enter into the options trading space. In the forex market, the biggest challenges for HFTs include general connectivity requirements and getting up to speed on how this market works.

Levas: Multi-asset high-frequency trading is going to come much

their HFT infrastructure needs. In fact, they are already going into exchange-owned data centers. A successful HFT today can outsource everything – co-location and data center locations, client connectivity networks, hardware, and even risk control access to execution venues.

Actman: Yes they are, using a third party gives HFT firms the ability to focus on their strategies and let the third party focus on everything else. Firms such as Lightspeed specialize in this service, and focus solely on providing the infrastructure for high-throughput, low-latency executions, and in certain circumstances, provide brokerage services. Firms that are just starting out or spin-offs that don't have the capital to build the infrastructure themselves can also benefit greatly from a third party. Almost all components of the HFT operation can be outsourced beyond generating the strategy itself, and even in those cases there are firms that are willing to also get involved in that process. It comes down to the secrecy game, and how much information these firms are willing to expose to a third party.

Wecker: For all but the largest firms, the technological complexity, scale and expense needed to be on the bleeding edge of ultra-low latency in many cases requires the services of a dedicated third party. HFT firms often specialize in creation of algos rather than building high-speed data and access platforms, outsourcing technology in most cases allows these firms to focus on what they do best. We



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more to the forefront, especially for global macro managers and firms like those. You're going to want to be able to get in and out quickly and efficiently, at the best possible price you can get. I think HFT will eventually get to all asset classes. The IntercontinentalExchange is far ahead of everyone else in commodities and futures, and there are other firms such as Goldman Sachs, Deutsche Bank, Credit Suisse and JP Morgan trying to get into this arena. There's definitely a migration, but it will take time and it's going to be implemented within the next one to two years.

Pritchett: At PhaseCapital, we focus on trading equities, and without question the high-frequency trading paradigm has pervaded equity markets throughout the US and other developed liquid markets around the world. That said, we believe that forex and futures markets increasingly attract high-frequency traders, and we are aware of growth in the markets for listed options, particularly with high-frequency traders deploying trading systems and strategies that compete with the more traditional OTC market-makers. In addition, systematic commodity trading adviser players are increasingly evaluating shorter-term horizons and automating their operations.

Q Waters: Are firms comfortable going to a third party for their HFT infrastructure needs? How much of the HFT operation can be outsourced?

Caudell: Yes, HFT trading infrastructure and operations are becoming very complex and normally involve myriad vendors. I find that many HFTs do not have or would prefer not to invest in the core competencies needed to implement and operate all areas of a given HFT trading environment. Third-party vendors such as Interactive Data 7ticks can provide various core competencies at an improved level of quality and reduced total cost of ownership.

While a large portion of the HFT operation can be outsourced, it is my experience that firms typically still want to handle development of their strategy and proprietary software.

Boyntin: Firms are absolutely comfortable going to third parties for



HFTs look to reduce latency by co-locating at third-party venues, either exchange-owned or facilities operated by third parties

Varghese Thomas, Savvis

are seeing more and more HFT firms going this route, especially with more and more strategies dependent on speed. Some trading strategies are more latency-sensitive than others, but traders most concerned with latency would do anything to minimize it, and that includes going to a third party if it delivers the best solution.

Thomas: In essence, HFTs look to reduce latency by co-locating at third-party venues, either exchange-owned or facilities operated by third parties. The degree to which a firm's operations can be outsourced is dependent on individual firms and what they feel comfortable in doing themselves versus leveraging third-party infrastructure and services. This is where a vendor that offers a range of services and a flexible approach can differentiate, since clients are able to pick and choose solutions as their needs dictate. In fact, at Savvis we have a number of examples of customers that take a blend of services comprised of co-location and managed services (for example, storage for historical data and back-testing algorithms). Others initially only required co-location services. However, over time they begin to outsource additional components of their operations as our relationship, and their confidence in our service, continued to grow. **W**

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