

# The Competitive Landscape for Global Exchanges

## What Exchanges Must Do to Meet User Expectations

### Authors

Peter Robin

James Greene

Cisco Internet Business Solutions Group (IBSG)

July 2008



Cisco Internet Business Solutions Group (IBSG)

---



## Foreword

I am delighted and honored to write the foreword for this Cisco Internet Business Solutions Group (IBSG) Point of View; and equally so to have participated in the Cisco Exchanges Survey, which provided many of the empirical and theoretical underpinnings for this study. Likewise, it was a pleasure working with the dedicated and thoughtful Cisco IBSG Financial Markets team, led by Peter Robin.

This is a most exciting time in the industry, with so much changing all at once. Much, if not most, of this metamorphosis is related to the nearly exponential growth of electronic trading, which finally appears close to taking over the entire global industry. It is fitting, then, that this POV is taking its place as a lead chapter in the book I am editing, *The Handbook of Electronic Trading* (Capital Markets Media, June 2008). I'd like to thank Cisco IBSG for its important contribution to the book.

When I started my Wall Street career some 25 years ago, and was fortunate enough to have actually written code for one of the first automatic execution systems for equities, the industry was a radically different place that would be unrecognizable today. In those days, it was all but a blank slate for trading automation, and electronic trading meant many things, depending on who you asked. The first critical step was getting rid of paper—handwritten order tickets and the manual trade blotter. As the trade magazine *Wall Street Computer Review* (known today as *Wall Street & Technology*) put it at the time, "Until nearly 1970, the securities business was wholly paper-based and manually processed. Ten or 11 million shares a day on the NYSE was a real backbreaker."

Fast forward to the middle of this decade, when I was managing director, trading technology and head of technology marketing at the New York Stock Exchange. The first time I ever heard anyone talk about measuring price dissemination and order execution times in milliseconds was when I was serving as chairman of an industry conference on—what else?—electronic trading. I naively thought that either they were joking, or I had misheard. Boy, was I wrong; and they certainly weren't kidding! Now, for better or worse, we already hear of some execution mechanisms, such as ECNs, ATSSs, SIs, MLTFs, and others, claiming latencies (i.e., turn-around times) in microseconds—yes, millionths of a second.

At a time when we have seen so much change, there has been a blurring of distinctions between exchanges and the multitudinous types of broker-/dealer-owned-and-operated trading systems, some of which are mentioned in the preceding paragraph. This phenomenon was quite elegantly and humorously captured years ago by Ruben Lee, in the introduction to his book *What Is An Exchange? The Automation, Management, and Regulation of Financial Markets* (Oxford University Press, 1998). In it, he states, "... New technology, however, has led to the birth of a previously unknown type of institution, the MONSTER (a market-oriented new system for terrifying exchanges and regulators)."

Let me close by thanking the 40 industry leaders who so graciously participated in the Cisco Exchanges Survey and allowed us to interview them. Without their support, this paper could not have been written.

Joe Rosen, President, RKA Inc.,  
Senior Adviser to the Cisco Global Exchanges Survey  
April 2008

---

## The Competitive Landscape for Global Exchanges

### What exchanges must do to meet user expectations

Financial exchanges worldwide are being buffeted by an unprecedented combination of forces—to a large degree driven by changes in regulation, market turbulence, and technology—that are transforming the environment in which they compete to a remarkable degree. To gain insight into this evolving marketplace, the Cisco Internet Business Solutions Group (IBSG) conducted a research study, the Cisco Exchanges Survey, which included interviews with dozens of senior industry executives. These were performed in the first half of 2007 and since updated to highlight key capabilities required from a leading exchange. The survey examined performance, low-latency issues, and technology as it pertains to global exchanges.

Among the main conclusions and findings of the study:

- Exchanges have transformed from members' clubs to commercial, profit-making organizations listed on their own exchange.
- Liquidity is the most important capability that an exchange must have. It is, however, a consequence of performing well on other capabilities. An exchange needs to offer a reasonable tariff of charges to its users; a high-performance, low-latency platform for price dissemination; and an efficient order-execution system. There are dozens of capabilities that an exchange must have, many of which are not under its control.
- Banks and other institutions that used to own exchanges resent that the exchanges now make profits from—and compete with—they. This conflict will intensify.
- Exchanges are competing with each other on a global basis to attract new listings and transaction flows.
- Mergers will continue, as exchanges have identified that “big is good” in an increasingly scalable business.
- Customers' expectations constantly are rising.
- Key exchange capabilities can be linked directly to increased revenue.
- New potential revenue sources exist for creative, forward-thinking exchanges.

#### **What Must Exchanges Do to Meet User Expectations?**

Reduce tariffs, improve latency performance, increase peak second transaction capacity, offer value-added services, increase transaction capacity through acquisitions and mergers, and stay two steps ahead of members.

## Background to the Cisco Exchanges Survey

The 40 senior executives interviewed represent a cross-section of buy-side, sell-side, and exchanges/ATs.<sup>1</sup> Organizations invited to participate in the study included, among many others, major industry players such as AllianceBernstein; Cantor Fitzgerald/eSpeed; Credit Suisse; D.E. Shaw; Deutsche Börse; E\*TRADE; Goldman Sachs; Highbridge Capital; HSBC Securities; ISE; ITG;<sup>2</sup> Lehman Brothers; London Stock Exchange (LSE); Madoff Investment Securities; Morgan Stanley; and the New York Stock Exchange (NYSE).

The individuals held a cross-section of senior roles. Titles included algorithmic trading head; CEO; CIO; electronic connectivity head; electronic execution/trading head; equity technology head; global operations head; head trader; institutional client group head; market data technology head; and prime brokerage head.

Cisco developed a series of questions that would enable participants to talk freely. Categories of questions included factors driving trading volumes; key capabilities of an exchange; impact of performance and latency; customer service; and the future of exchanges. Also, the survey asked, “What do you see as key differentiators of one exchange versus another in regards to trading technology, dealer support technology, regulatory structures, clearing, and settlement?”

The study’s industry research included sources such as the World Federation of Exchanges, various analyst reports, and news services/press coverage.

We should note that a major part of the study took place before the following mergers: NYSE/Euronext; NASDAQ/OMX; Deutsche Börse/ISE; CME/CBOT; and LSE/Borsa Italiana. These firms, therefore, were evaluated as separate organizations.

## Competitive Environment for Exchanges

It seems that a perfect storm of factors is now reshaping the global securities industry and the traditional exchange trading business more than any other segment. The trends and buzz words commonly cited, most of which are highly interrelated, include demutualization and IPOs; diversification; globalization; consolidation, mergers, and joint ventures; technology advances; explosive growth in algorithmic and electronic trading; de-/re-regulation; demanding customers and pricing pressures; aggressive new entrants; fragmentation of liquidity; and convergence.

Essentially, this translates into a confusing blurring of distinctions between and among segments and players, resulting in a near free-for-all, where almost everyone competes with everyone else. For example, most major investment banks have their own internalization and/or crossing engines, which siphon executions directly from exchanges; this is one manifestation of convergence.

---

1. Alternative Trading System: A regulator-approved, non-exchange trading venue.

2. Investment Technology Group.

But it gets more interesting as the competition among brokers and exchanges extends in more cases to the entire trading value chain, including the pre- and post-trade, in addition to the trade execution itself. By building and/or buying—and providing to customers—applications/functions such as order management systems (OMSs), transaction cost analysis (TCA), connectivity tools, and market data distribution platforms, these organizations give customers more reason to trade with them. This further manifestation of convergence, and its resultant, growing friction between the sell-side and exchanges, is an example of vertical diversification by both.

The entry of aggressive new competitors—in particular, various types of ATSs—has been facilitated, if not encouraged, by Reg NMS<sup>3</sup> in the United States and MiFID<sup>4</sup> in the European Union (EU), causing pricing pressure and, arguably, improvement in performance. And enter they have. According to a recent report by the research company Tabb Group, “...there are more than 55 different venues where buyers and sellers electronically trade U.S. equities.”<sup>5</sup>

Figure 1 lists a subset of 30 ATSs, a growing number of which now are active in both the United States and the European Union.

**Figure 1.** List of Players—Dark Pools<sup>6</sup>

**U.S./European Dark Liquidity Pools**

An expanding list of players

Sponsor	Dark Pool	Sponsor	Dark Pool
Pipeline Trading Systems	Pipeline Block Trading System	Morgan Stanley	ATS1
eSpeed	Aqua	BIDS Trading	BIDS Trading ATS
Bloomberg	Block Hunter	Merrill Lynch/ITG	BLOCKalert
Automated Trading Desk	Institutional Match	Fidelity Brokerage	CrossStream
Investment Technology Group	POSIT Match	eBX	LevelL
Instinet	Instinet Global Crossing	State Street	Lattice
Liquidnet	Liquidnet	NASDAQ	Midpoint Reserve
Liquidnet	Liquidnet H <sub>2</sub> O	NYSE	Matchpoint
BNY ConvergeX	VortEx	ISE	Midpoint Match
Investment Technology Group	POSIT Now	UBS	UBS PIN
Knight	Match	Goldman Sachs	SIGMA X
NYFIX	Millennium ATS	Merrill Lynch	MLXN
NYFIX	Euro Millennium	Morgan Stanley	MS POOL
River Cross	River Cross	Lehman Brothers	Liquidity Center Cross (LCX)
Credit Suisse	CrossFinder	Citi	LiquiFi

Source: Celent, 2007

3. Regulation NMS (or Reg NMS) is a regulation promulgated by the United States Securities and Exchange Commission (SEC). According to the SEC, Reg NMS is “a series of initiatives designed to modernize and strengthen the national market system for equity securities.”

4. Markets in Financial Instruments Directive.

5. “U.S. Equity Market Structure: Driving Change in Global Financial Markets,” Larry Tabb, March 5, 2008.

6. Dark Pool: A source of liquidity that is created by institutional trade orders not available to the public. It usually refers to block trades facilitated on an ATS and off the central exchange.

New entrants also have been gaining traction. Nomura/Instinet-owned MTF Chi-X in the European Union lately has been trading nearly 10 percent of the London Stock Exchange volume. Similarly, ECN BATS Trading in the United States, which recently applied to the SEC for exchange status, has been doing 11.3 percent of NASDAQ and 8 percent of NYSE volume. Many new entrants, as well as some revamped, older ones, have been created as joint ventures of multifirm consortia. The extent of this phenomenon, across asset classes and geographies, and based on level of broker/dealer participation, is illustrated below.

Figure 2. The Altered Broker/Dealer Landscape

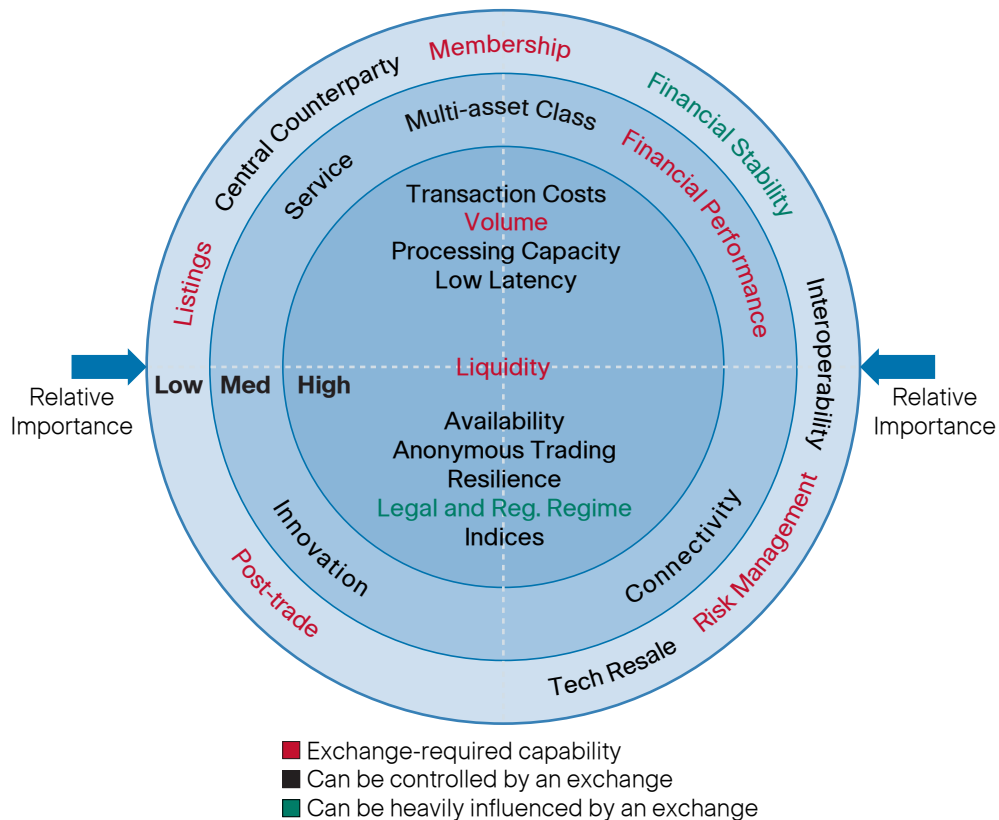
	Execution Platforms													Post-trade Platforms																														
	Equities	Rates	Credits	GF	Equities	FX and Commodities	Exchanges	Rates	Credit	FX	Data																																	
	LiquidityHub	MTS-Bondvision <sup>(a)</sup>	Bonddesk	MarketAxess	Creditex <sup>(a)</sup>	GWIXX	RPWire	BIDS	LeVel	Turquoise	Archipelago	BATS	TradingScreen	EBS	FXall	Currenex	Volbroker	Climate Exchange	USFE	ISE	NSX	Chicago SE	Philadelphia SE	India National SE	Boston Options E	SwapsWire <sup>(a)</sup>	DTCC	Clearing Corporation	LCH Clearnet	Euroclear	T-Zero (Creditex)	CLS	BOAT	Markit	Themarkets.com									
ABN-AMRO	✓	✓	✓	✓										✓												✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓							
Bank of America	✓	✓	✓	✓						✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓						
Barclays Capital	✓	✓												✓													✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓						
Bear Stearns			✓	✓			✓														✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓						
BNP Paribas	✓	✓											✓	✓	✓											✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
Citigroup	✓	✓				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
Credit Suisse				✓			✓	✓	✓	✓	✓	✓	✓	✓	✓							✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
Deutsche Bank	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
Goldman Sachs	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
HSBC	✓	✓					✓						✓	✓	✓											✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
JPMorgan	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Lehman Brothers	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Merrill Lynch	✓						✓			✓	✓	✓	✓								✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Morgan Stanley	✓										✓	✓	✓						✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
RBS	✓	✓											✓	✓	✓											✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Société Générale	✓	✓											✓	✓	✓											✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
UBS	✓	✓	✓				✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Source: Deutsche Bank, 2007

## Exchange Capabilities

Through interviews, discussions, and research, we determined more than 50 capabilities against which to measure an exchange's performance. Figure 3 contains 23 different capabilities; the capabilities toward the center are more important than those at the outer edges of the diagram.

Figure 3. Key Capabilities Defining an Exchange



Source: Cisco IBSG, 2008

We focus on the 10 high-priority items in the middle circle, but also will touch on some outside items. High performance, low latency is very important, but isn't the most essential capability an exchange must have. Our research showed that the most critical capability is liquidity, because without it, you can't trade. In fact, liquidity is a consequence of getting everything else correct. Some exchanges were surprised to find that they weren't directly in control of liquidity. It was an eye-opener for some exchanges to discover the capabilities they could control (investment candidates) and those they could not.



Since exchange customers and former members regret, to a large extent, that exchanges are making profits from them, they have been focusing on trying to convince exchanges to reduce costs. Our research, however, shows that the transaction cost element represented by an exchange in the total cost of buying, selling, and processing equities represents only about 4 percent of the total cost. So, members should focus on the other 96 percent of total costs.

We bundle several capabilities together in what we call “invariant execution” by the exchange. Users want the performance of an exchange—latency, distribution of prices, and processing of trades—to remain unchanged, no matter what the trade volume. It’s easy to process just one transaction at a very high speed. But if you are processing 100,000 trades a day, and you have a surge that might put through another 20,000 trades, then it is not so easy to maintain a constant performance. Processing capacity and volume handling are very important to users. It also is critical that the exchange be available. If you look back over the past five or six years, there have been a number of exchange failures—some for only a few minutes, some for several hours. But whatever the situation, users want the exchange to remain available.

The exchanges to whom we spoke felt that they were in control of all the capabilities they needed, but manifestly they are not. Take, for example, the legal and regulatory regime. Many exchanges mentioned that they were in control of the rules, regulations, and laws that concern trading. We brought up the counter example of Sarbanes-Oxley, which prevented companies from listing on U.S. exchanges because it was too expensive to comply with the regulations. Similarly, in the United Kingdom, the government imposed an advanced corporation tax on share trading and stamp duty that has impacted the volume and cost of trading on the LSE. For each exchange, we can find an example where it is absolutely not in control of the regulatory regime. What exchange users want, however, is for the regime to be certain, even if they do not find it perfectly favorable to their business situation. So, basically, the exchange is in control of letting its members know what the rules are.

Some exchanges were quite limited (trading, for example, only cash equities), whereas other exchanges trade the whole range of financial instruments. As part of their efforts both to diversify and grow the scale of their business, almost all the major players have been busy acquiring exchanges outside their core. For example, Deutsche Börse bought ISE partly for its growing equities business, and NYSE acquired Euronext—a pan-European exchange based in Paris, with subsidiaries in Belgium, France, the Netherlands, Portugal, and the United Kingdom—largely to enable its diversification into the futures business via LIFFE CONNECT, a leading global derivatives trading system.

Most exchanges do not provide clearing and settlement functions, such as Central Counterparty, a financial institution that acts as an intermediary between security market participants. Those that do, however, gain a competitive advantage over other exchanges, including making more money. One of the reasons that the IntercontinentalExchange (ICE), which operates global commodity and financial products marketplaces, bought the New York Board of Trade (NYBOT) was for its

---

registered clearing license and business. In both the European Union and United States, sentiment among regulators seems to be away from the vertical silo model, whereby an exchange owns its clearing corporation. Regulators appear to be making threatening sounds to break up the vertical model. For example, the Chicago Mercantile Exchange (CME) is being examined to decide if it should divest its clearing business.

One more high-priority capability that must be considered is the exchange's peak second transaction volume capacity. Difficulties occur, and the throttles need to be applied, when all trades are trying to get through at one time. These peaks typically occur at the start and end of a trading session, or in response to news. They also emanate from the continued growth of algorithmic trading. An exchange's data distribution and trading systems must cope with ever-increasing frequency of peak seconds that put the greatest strains on capacity. In the words of a European exchange executive, "If an exchange is not prepared for the increased volume, it could take an exchange down."

## Performance and Revenue Drivers

Key exchange capabilities can and must be linked to economic impact. In other words, what should be important is how to optimize revenues and profits. Exchanges, therefore, should focus investments on capabilities and factors over which they have control, and that will lead to higher volume of trades—the highest charging element for most exchanges. The proportion of an exchange's business that comes from algorithmic trading, largely from statistical arbitrage hedge funds and sell-side prop desks, already is high and rising. Estimates for the NYSE are that upwards of 60 percent of its trade volume is generated algorithmically, and it's even higher for NASDAQ. For the LSE at the end of 2007, it was greater than 50 percent. As the number of total orders increases, a result of algorithmic trading, so, too, does the need for improved latency in the exchange platform to process all the orders in the required time frame. On balance, the reduction in latency of an exchange's systems facilitates increased order and trade flow and, thus, more revenue. LSE, for example, noticed a 30 percent rise in trades when it introduced its new trading system, TradeElect. It's debatable whether this purely was because the exchange provided increased performance or if it was due, in part, to its improved volume-handling capacity as well.

What makes the investment decision for improving latency performance more interesting for an exchange is that, by and large, customer systems are nowhere as fast as those of the exchanges. So the question arises as to where to invest the money that would have been invested in further reducing latency? For some, the answer is easy. Exchanges need to ensure that cancel processing procedures are at least as good as the order-receive and execution processes. As it turns out, there are, by far, many more orders sent than trades executed. The ratios range from five orders to one execution for a typical equities-only exchange, to many hundreds or more at some derivatives exchanges. This also is a potential revenue opportunity for those exchanges not currently charging for cancels, since cancels are the main transaction type going through the exchange's system.

Our analysis suggests that it would be highly advisable for exchanges and customers to cooperate fully and disclose their technologies to each other. This will result in better performance and attract more flow to the exchange. This also could provide potential revenue for the exchange in the form of IT advisory services to its members, particularly as it relates to improving latency performance.

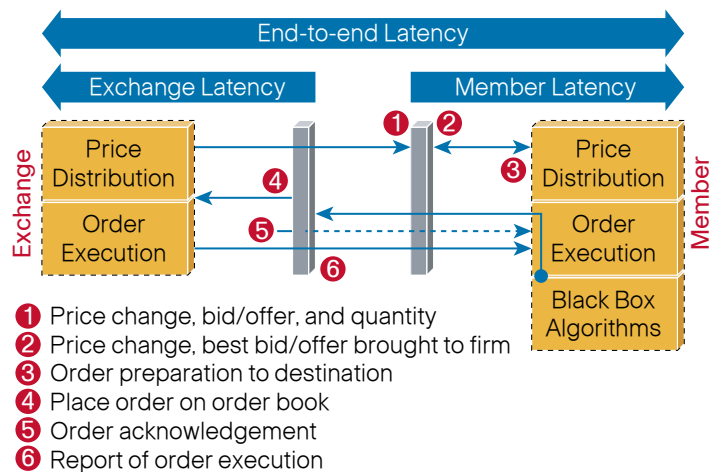
Exchanges should be aware of the operability of elasticity of demand in the trading business, i.e., that a reduction in price could lead to higher revenues if the volume increases at a higher ratio than the price cut. A case in point is BATS Trading, which, via clever usage of price cuts, as well as extensive rebates for liquidity providers on its order book, cemented its position as the third-largest U.S. equity pool, after the NYSE and NASDAQ.

As part of our study, we asked interviewees to rank eight leading exchanges— CME, Deutsche Börse, Euronext, ISE, LSE, NASDAQ, the NYSE, and TSE—on a scale from 1 (poor) to 5 (excellent) based on the 10 high-priority capabilities of the inner circle in Figure 3. There was much clustering, but also interesting deficiencies and almost comical outliers on some attributes, especially regarding service, capacity, and performance/latency. We suspect that once the competitive impacts of MiFID are felt via, for example, Chi-X (the first order-driven pan-European equities multilateral trading facility) or Turquoise (an ATS in formation), there will be radical changes in the ratings.

## Importance of Low Latency<sup>7</sup>

High-performance, low-latency trading is of great interest to all involved parties in a trading mechanism. Figure 4 shows some of the key timings to be considered both by an exchange and its users.

Figure 4. Latency in an Exchange System



Source: Cisco IBSG, 2008

7. Disclaimer: Timing figures quoted are based on information provided by those interviewed. They have not been measured or verified by Cisco and may differ from information published by a given exchange.

---

The first thing we observed is that there are no uniform definitions for latency. One exchange can quote one millisecond for price formation, and another can quote two milliseconds, but they are not necessarily talking about the same thing. It would be useful for a central body to develop some uniform definitions for latency to facilitate comparisons.

From the exchange point of view, there were two important functions that we monitored: price dissemination/price distribution and order execution. On the member side, there's the opposite factor—how rapidly can prices received from the exchange be processed? We also have to consider the order-execution function.

In Figure 4, we've labeled the arrows. The first activity is that an exchange will publish the price at which trades are being executed for a particular stock (arrow 1 in Figure 4). By now, most exchanges already perform pretty well, with a typical time range of between two to five milliseconds in terms of price dissemination. But times do vary, with very good times around one millisecond. NASDAQ, for example, claims that it disseminates prices within one millisecond of trades being done. To a very poor outlier exchange, which can take up to 18,000 milliseconds to disseminate the price of a trade, this is a very long time.

BATS Trading is faster still, disseminating prices in about 400 to 500 microseconds, and producing an order acknowledgement within 400 microseconds of order receipt. The LSE, for example, produces results in two milliseconds. The NYSE takes between three and five milliseconds, and it's working to reduce that to two milliseconds. Deutsche Börse distributes prices within two milliseconds.

The next element of time travel, along arrow 1 in Figure 4, is the transmission time from exchange to member. Typically, it's in the four- to five-millisecond range and, because of the laws of physics, cannot be improved much. Various techniques might help, such as employing dark fiber connections, or the famous collocation strategy. The idea is to put as much relevant processing as close as possible to the exchange, maybe even in the data center of the exchange itself, and as little as possible on your own premises if you are a member or an investment bank. Some exchanges have started to turn this into revenue, charging for the real estate in their data center.

We are reminded here of a Japanese proverb, which says that "nearer is farther." The principle is that the more functionality you put near the exchange, the farther you are from your user base for price. That is why you need a strategy. If you can receive price data within 500 microseconds, but you still can't distribute it to your user base in 20 milliseconds, you really haven't gained anything. Interestingly, not all hedge fund traders are requiring high speed if they are not involved in automated trading.

Members must be able to handle and process all prices that are received. In a reasonable high-performance trading venue, prices are generated in one or two milliseconds by the exchange and transmitted to members in four to six milliseconds.

A median response time for price-handling mechanisms is around 100 milliseconds. In this situation, there is little point in pushing the exchange for improved processing time until members upgrade their own systems. For some of the members to whom we spoke, this was quite a revelation. Exchanges shouldn't necessarily spend any more money improving latency performance. What they should be doing is improving capacity, because many members couldn't cope with an improvement in latency performance. We do see some members, however, claiming that they can handle prices within two or three milliseconds.

Typically, order-execution times are slower than price-dissemination times, although that's not invariably true. At the time of the survey, main board exchanges were achieving times between 25 milliseconds and 100 milliseconds for order execution. But, in fact, all exchanges have improved since the time of the survey. The LSE now executes at best within eight milliseconds, with a median of 14 milliseconds. The NYSE claims to execute at between 10 and 25 milliseconds. NASDAQ will claim to be within 15 milliseconds. BATS Trading is much faster than that, producing results within five milliseconds. By contrast, the outliers probably are around 250 to 500 milliseconds for execution. NASDAQ and NYSE latency performance improvements are largely due to their Inet<sup>8</sup> and Arca<sup>9</sup> acquisitions, respectively.

In Figure 4, arrow 5 is important because of what the algorithms used by members require. It is an order acknowledgement, which they want as rapidly as possible. All exchanges send an acknowledgement to the originator to confirm that an order has been placed on the books, but some exchanges also provide an "order ack," which confirms only that the exchange has received the order. Black box strategies rely on the "order ack" to trigger the next response. BATS Trading, for example, claims 500 microseconds on this particular aspect, the LSE one millisecond, NASDAQ one millisecond, and the NYSE two milliseconds.

At the time of the survey, one of the participating exchanges surprisingly did not provide an order acknowledgement. As a result, it changed its policy to be more attractive to quantitative hedge funds.

All exchanges would like standardization and normalization of protocols used. The Financial Information eXchange (FIX) protocol seems to be the obvious candidate. FIX is a protocol of messaging specifications for the electronic communication of trade-related messages, but it is not a compressed protocol, whereas FAST is (FAST is FIX adapted for streaming). High-speed traders would like to receive pricing using the FAST protocol.

---

8. NASDAQ's Electronic Crossing Network.

9. NYSE's Online Securities Exchange.

---

What people find useful is discussing where and how latency arises in the system. All things considered, the more you reduce the number of “hops” between systems, the lower latency you are likely to achieve. But it’s important to measure what’s happening here. Time-stamped transactions are highly important in understanding where delays are being incurred. Measuring time in itself is not going to improve performance, but it will tell you where to focus energy and effort.

Regarding accuracy, if we were in the old days, and times of a hundred milliseconds were being incurred, then perhaps measuring times to an accuracy of one millisecond would be perfectly adequate. In the current world, where some are talking of reducing latency to less than 100 microseconds, timings must be accurate to within microseconds.

One must distinguish between accuracy and precision. There are many devices along the chain, and all contain clocks that may generate time to within 10 decimal points. The time that’s produced, however, may not be accurate unless it is in current time. In addition, the second you are measuring may not be the same duration as the second that you next measure.<sup>10</sup> If you are looking for accuracy, you want each second to be identical in length and the same as real time. People have been searching for a universally recognized reference in terms of timing. Of course, the process of time stamping itself can add latency into the system, so you have to adjust for that. But at least you know whether you are going to focus on the firewall or your order management system in terms of reducing latency.

An important point to bear in mind is the existence of a positive feedback loop for well-performing exchanges, whereby low latency in data distribution triggers more electronic order flow as response time is narrowed.

Critical as low latency is to some, customer segments differ in views on just how important it is. For example, the global head of electronic trading at a sell-side firm said, “Latency affords bragging rights for exchanges; actual value isn’t there. Once people can’t perceive the difference, latency is immaterial.” On the other hand, the competitive impact of poor latency performance on an exchange can be devastating. According to the global head of trading at a hedge fund, “Latency is very important to program trading. . . . It’s easy to lose liquidity. AMEX lost exchange-traded funds (ETFs) because of latency. It took five seconds to get a fill.”

---

10. System clocks do not necessarily run consistently. One second may really be 100,000,000 beats. The first “second” generated by the clock, however, may be 99,999,999 beats, then the next may be 100,000,001 beats.

## Conclusion

Although exchanges have evolved from human-centered, paper-based institutions to high-speed, electronic platforms in a relatively short time period, they cannot afford to be complacent.

With their transformation into listed, quoted companies, exchanges need to seek value-adding revenues and profits from their members and users, and capture a greater share of transaction flows on a global scale. This requirement has prompted the rash of merger and acquisition activity seen in recent years. In parallel, legislation and market forces have eased the development of alternative trading systems. These newer trading vehicles are snapping at the heels of the established exchanges, making real inroads into the transaction flow.

Not only are exchanges competing with each other on a global basis to attract new listings and transaction flows, but banks and other institutions that used to own the exchanges now are in direct competition with them and are resentful of exchanges profiting from them. This conflict will intensify. Obviously, the environment for global exchanges shows no signs of becoming easier or less competitive.

With customer expectations constantly rising, improved capabilities must be provided to ease customers' processes. Exchanges must reduce tariffs, improve latency performance, increase peak second transaction capacity, offer value-added services, increase transaction capacity through acquisitions and mergers, and embrace newer technologies to maintain their position and stay two steps ahead of the competition.

In general, exchanges are doing an excellent job of meeting customer needs. To stay on top, however, exchanges must invest creatively in key capabilities that are under their control, and that can be linked directly to increased revenue opportunities.

---

### More Information

The Cisco Internet Business Solutions Group (IBSG), the global strategic consulting arm of Cisco, helps CXOs and public sector leaders transform their organizations—first by designing innovative business processes, and then by integrating advanced technologies into visionary roadmaps that address key CXO concerns.

For further information about IBSG, visit <http://www.cisco.com/go/ibsg>

---



**Americas Headquarters**  
Cisco Systems, Inc.  
San Jose, CA

**Asia Pacific Headquarters**  
Cisco Systems (USA) Pte. Ltd.  
Singapore

**Europe Headquarters**  
Cisco Systems International BV  
Amsterdam, The Netherlands

Cisco has more than 200 offices worldwide. Addresses, phone numbers, and fax numbers are listed on the Cisco Website at [www.cisco.com/go/offices](http://www.cisco.com/go/offices).