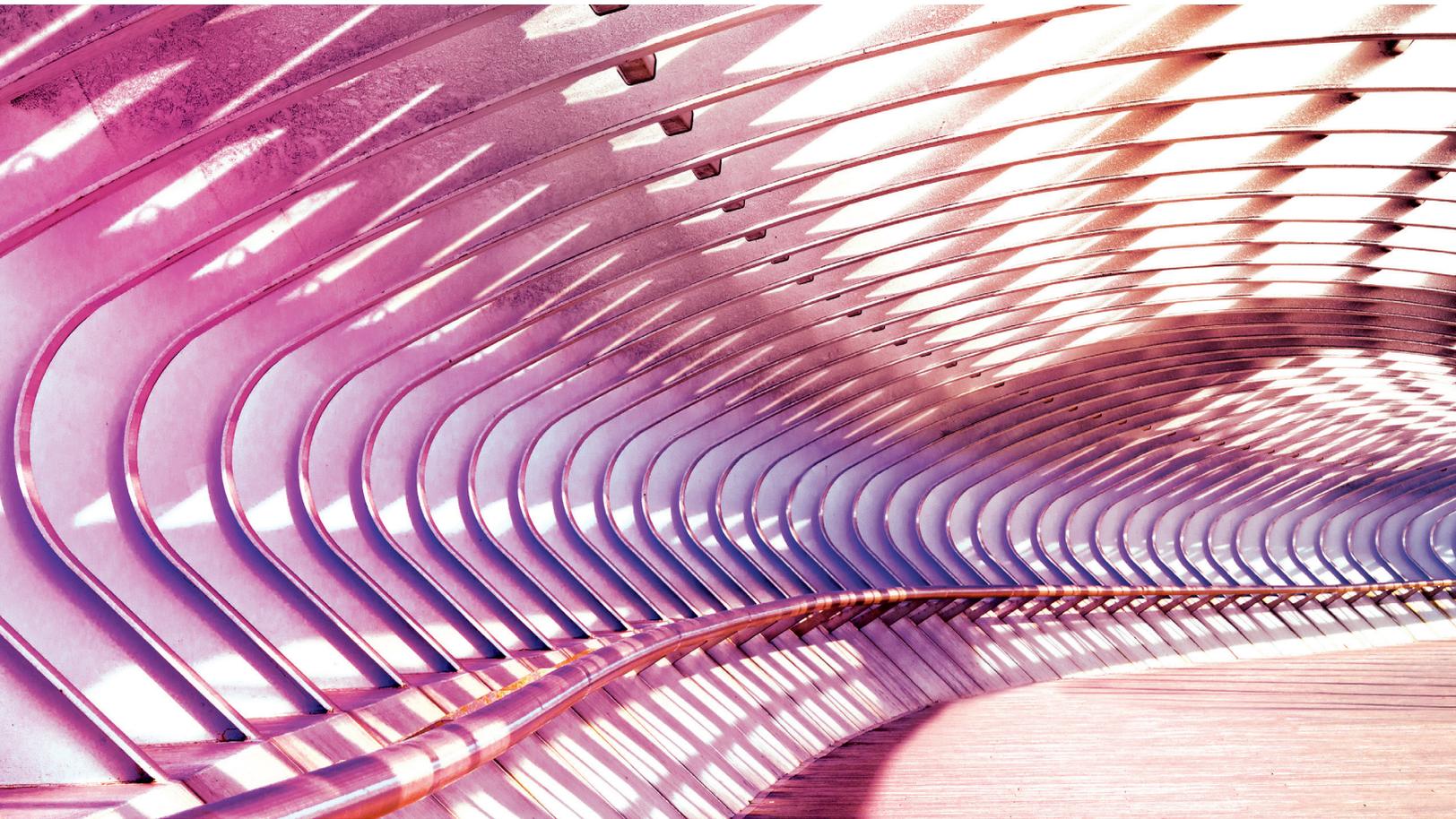




Transformational change

enabling global trading communities through
electronic connectivity

White paper



Executive summary

Introduction to Critical Connectivity

Electronic trading, and the global inter-connectivity that enables it, has re-defined global capital markets in this century. What began the 2000s as a loosely-dependent collection of isolated domestic markets has transformed into a global trading community of symbiotic markets. These markets may be exchange-based, or not; they may be dark or lit. They cross asset classes and jurisdictions to encompass all market participants and the ecosystem of end-to-end supply chain partners that facilitate the trade process.

In a single generation capital markets have moved from open outcry and telephone trading, to electronic click-and-trade and fully-automated, straight-through processing in which a human is not involved in any step of the trade from analysis, to decision-making, to trading, clearing and settlement.

While trading volume occasionally fluctuates in its growth, market data rate growth seems ceaseless. For example, this century has seen the capacity of the Options Price Reporting Authority's systems increase by more than 400,000% from their 3,000 messages per second data rate at the turn of the millennium.

It's not just the sheer volume of data that presents challenges. Traders are drawing from new types and sources of data for making decisions. They're moving beyond structured data to explore all the news and unstructured web, Twitter, Facebook, and other content available today. Traders use smartphones, social media and other connecting utilities in all aspects of their lives and expect to be just as connected at work.

The beginning of the 21st century has witnessed an unprecedented transformation in financial markets driven by technology, market upheavals and regulation. Today's markets pose growing challenges of scale, diversity and risk, while traders need to connect to an increasingly diverse range of counterparties, venues and electronic services geographically dispersed around the world. In this context, successful trading strategies depend as much on agility as they do on speed.

Connectivity is the great enabler that facilitates access to the diverse data sources and business partners that turn ideas and algorithms into successful trading strategies. Connectivity is also about synchronized service excellence across a highly dynamic supply chain that changes trade by trade, focused on effective self-service and seamlessly supported by responsive expertise centers. Connectivity is about turning business relationships into business success.

Global companies now recognize that consolidating connectivity assets can turn technology infrastructure costs into business opportunities. Smaller, local and regional firms are leveraging their connection to respond to rapidly growing demand for local expertise. Financial connectivity allows market participants of all sizes to contribute to the transformation of global markets and to access growing global demand. Understanding these trends can empower firms to choose the best long-term partners for growth.

 *Connectivity is the great enabler that facilitates... successful trading strategies.*

Greater transformation drives the need for a Greater Community

Regulatory changes in the United States and across Europe since the beginning of the millennium have opened up competition and given rise to new opportunities. Regulations such as Reg NMS, Dodd-Frank, MiFID, UCITS, Sarbanes-Oxley, and the Basel initiatives have fostered competition, eliminated traditional monopolies and reduced risk while increasing administrative costs and burdens for firms. These regulations have also fragmented liquidity and driven markets to find new technologies and develop new products in order to uncover profits.

What emerged was a highly competitive network of multi-asset trading venues offering both lit, i.e. transparent, and dark liquidity with a profusion of commercial terms and market microstructures. Market timing measurement for both market data and trading changed from being measured in seconds to microseconds and nanoseconds; peak market message rates for equities and related derivatives similarly rose in the United States from thousands per second to tens of millions per second and billions of ticks per day.

Remote electronic access has expanded the trading environment from a single venue with a few dozen familiar faces on the floor to thousands of machines and humans scattered around the globe, each with very different investment profiles, cultural values and risk sensitivities. Capital markets have entered a new era of global scale, diversity and risk.

In an environment of liquidity fragmentation, high-frequency algorithmic trading (HFT) serves to keep prices and spreads aligned. With the majority of U.S. 'liquidity' represented by HFT, low latency and big data are taken for granted as characteristics of modern markets. In order to reduce latency, trading engines – including many broker algorithms – now reside in colocation data centers next to the trading venues or in proximity trading hubs. At the same time, the commoditization of technology and race-to-zero are reducing the competitive advantage that HFT held just a few years ago.

Large money managers are hiding more of their liquidity in dark pools to avoid exposing their trading strategies,

Capital markets have entered a new era of global scale, diversity and risk.

while the large brokers have developed sophisticated anti-gaming software to protect their clients from predatory strategies.

Many high-frequency traders are beginning to consider exotic hardware solutions like field programmable gate arrays (FPGA) or graphical processing units (GPU). FPGA chips can drive latencies down into nanoseconds with virtually no jitter. GPU chips with hundreds of cores can undertake compute-intensive numerical analysis in real time.

While there are still profits to be had, these technologies involve huge investment and may have diminishing returns in the future. Therefore, traders are gradually diversifying their strategies to avoid the crowd and reduce their reliance on pure speed alone.

Some high-frequency traders are looking to arbitrage different asset classes or global markets, including emerging markets in Asia, the Middle East, Latin America and Eastern Europe. Others are exploiting alternate sources of structured and unstructured data like news feeds, web content, blogs, social media and twitter to squeeze out some slim time advantage. Indeed, traders are leveraging a diverse range of data sources, including data generated by the trading technology itself such as latency and queue lengths. Advisory liquidity indicators are also being exploited by some investment firms, such as 'indications of interest' (IOI) feeds from brokers, fundamental macro- and micro-economic time series data, and even weather telemetry readings.

Greater transformation drives the need for a Greater Community (continued)

Markets themselves have responded in kind with alternating bull and bear cycles. The globalization of economies and financial markets, geopolitics and the financial crisis has caused uncertainty, market declines and lack of liquidity. However, these macro-events have also resulted in surges of volatility, bubbles and panic. Investors have repeatedly switched between 'risk on' and 'risk off' strategies, either seeking yield in booming emerging markets or running for safety to deep pools of dollar liquidity.

According to the World Federation of Exchanges, flows of funds and the overall global capital balance has changed from being strongly in favor of North America and Europe to more investment in the developed nations of Asia-Pacific, as well as emerging, frontier and other regions of the world that are now much more accessible thanks to the globalization of markets and democratization of technology.

“*The thrust of innovation today is to build global trading communities that connect market participants to service providers and liquidity venues across asset classes and geographies in an ecosystem that enables the trade process.*”

Connecting the Dots

The evolution of markets has forced banks and trading firms to think globally and seek revenue opportunities around the world. Even smaller local and regional firms must contend with events halfway around the world.

Through all of this evolution, connectivity is a huge component of success. Connectivity enables investment firms to react to and exploit opportunities whenever and wherever they arise. A well-developed connectivity strategy is not only critical for the IT department, it can

actually be the catalyst for building and maintaining relationships with customers, suppliers and business partners. Implementing such a strategy depends on four key characteristics:

- Building the Global Community
- Maintaining Corporate Agility
- Ensuring Dependable Returns
- Synchronized Service Excellence

Building the Global Community

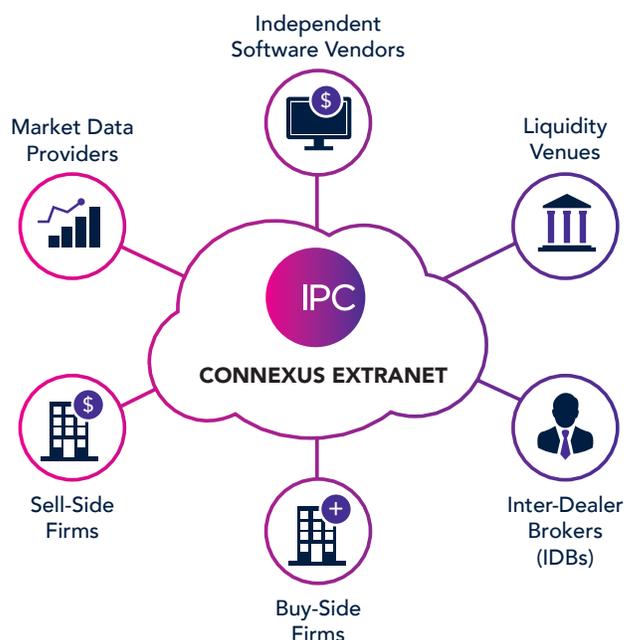
Traditionally, investment firms have evaluated connectivity suppliers by their ability to meet a highly detailed request for proposal, listing all of the points of presence and telecommunications capabilities required. In today's global markets, it's not so much where you connect as with whom you connect that matters. Because technology evolves so quickly, specific technology components and implementation are not so important. Rather, service level commitments are the characteristic that is critical to guaranteeing best service.

Pre-existing connectivity to markets, brokers, interdealer brokers, buy side firms, post-trade processing utilities, data vendors or independent software vendors creates future choices that can be called at short notice. Suddenly ubiquity becomes as important as latency to ensure companies have the ability to react to changes in the market. Indeed, there is no point in being fast after the opportunity window has closed. Access on demand is everything in 21st century financial markets.

Moreover, firms need connectivity partners with global reach and local expertise in the markets to which they connect. Country coverage is important, even for firms not yet operating in emerging or frontier markets, since globalization is progressively affecting everyone.

Connectivity providers with large communities will similarly be more attractive to new users, so persuading one's counterparties to connect becomes easier. If two

counterparties are connected through one provider, they can communicate directly and workflows can be optimized much more easily. The existence of a community directory is an important asset since it turns every member into a potential resource to solve the next problem for their community neighbors.



“Investment firms are looking for connectivity that provides both global reach and local expertise.”

Maintaining corporate

Agility

A large existing footprint in the financial community already creates agility by reducing time-to-market and sharing costs. This is efficient only if there is a service level agreement (SLA) to ensure firms can connect to each other very quickly via the relevant communications protocols. Most financial firms use FIX, SWIFT/ISO20022, TCP/IP, UDP or multicast protocols as well as dedicated high-speed exchange protocols. A firm's connectivity must support all of these, as well as incorporating new standards as they are agreed.

Scalable capacity is another issue. When volatility strikes, capacity limits can dramatically impact latency just when you most need dependable response times. Firms need scalable options that can be quickly switched on or off, if message rates suddenly spike.

However, corporate agility also includes the ability to customize the offering. A sell-side firm may wish to sponsor a buy-side customer's connectivity to its

electronic trading platform while integrating it with an internal virtual private network (VPN). This might also include voice services, either conventional voice over IP, or dedicated trading communications applications. The ability to customize connectivity in any country and manage it within a single performance framework and SLA is important. Reduced lead times for onboarding naturally accelerates revenue growth.

A hedge fund or proprietary trader might similarly need 10 Gbps connectivity to multiple exchanges for low-latency, high-frequency statistical arbitrage trading, while using lower bandwidth connections to other brokers or post-trade services. The ability to mix lower-cost services and premium-rate dedicated services with the same vendor and through the same connection adds flexibility to the connectivity infrastructure, allowing firms to quickly swap service connections as business needs require. This allows for agile, short-term service options to become feasible.

“ Access on demand is everything in 21st century financial markets.”

Ensuring

Dependable Returns

Of course, performance of the connectivity infrastructure is critical in every sense. Human traders at their terminals may barely register events below 100 milliseconds. However, most trading takes place at 'machine speeds' where even nanoseconds may matter. Moreover, markets are their busiest when volatility is high, and this is precisely when traders need dependable latencies. If any system component of a firm's trading infrastructure cannot keep pace, then the firm is not really in the market.

The IP MPLS protocol is designed to produce dependable latencies and reliable throughput against each defined class of service. In fact, consistent latency is usually more important for HFT algorithms than lower

latency in an absolute sense if reliable trading returns are to be sustained. The connectivity infrastructure should, of course, be fully-redundant and sufficiently resilient so that there is essentially no down time for the customer. This 100% service availability should be defined in the SLA.

Capacity requirements must be calibrated against expected peak throughput in consultation with the exchanges or relevant brokers. Experienced technologists will often require provisioning between 10x and 20x the expected peak data rates in order to confidently avoid transient jitter. Actual capacity use will need to be monitored closely. The system should do this autonomously with threshold alerts.

Synchronized

Service Management

With electronic trading customers must be provided with the capability to manage their own services. Transparency is key with complete information and monitoring tools available through the application programming interface (API). Diagnostics, statistics and other information from exchanges must be incorporated into trading algorithms. Exchanges differ enormously in their network services. Some utilize single data streams, while others multi-stream using TCP/IP, UDP or multicast protocols. Some provide re-request channels to backfill lost data, while others do not. Error diagnostics may range from dozens of codes to a mere handful. There are many flavors and they all impact latency as well as reliability. Firms need to synchronize their own electronic trading service management and their IT and network engineers with exchanges, brokers and other providers in their service supply chain.

“*Electronic connectivity is not just a pipe for connecting to a market. Rather, it is a marketing and delivery channel for financial services.*”

International connectivity inevitably involves a hierarchy of carriers and service providers. In such large, complex, and dynamic global infrastructures, technological errors may occur at any point and at any time, highlighting how service management directly impacts a firm's P&L. Network topologies with diverse, easily scalable routes are essential to managing costs. One hundred-percent reliability is essential to a successful trading business.

In most instances, firms will realize more reliable, better synchronized, and often less expensive service by utilizing a global connectivity provider. Many connectivity strategies that firms implement lack the design, global reach or service management to address the unique pressures of financial markets.

White paper

Conclusion

The great transformation in financial markets since the turn of the millennium has forced banks and trading firms to take a global view of every aspect of their business including customers, investments, technology, risk management and compliance. Viewing each of these as an asset changes the approach from one of cost management to one of maximizing return on assets.

Trading communications, traders and operational managers recognize how sharing a common, global communications infrastructure provides the business with the agility needed to quickly respond to and take advantage of opportunities wherever they arise in the world.

An intimate connection to local markets is critical to the ability to provide true global service, including local language service delivery, synchronized, 24x7 customer support and an understanding of local commercial and regulatory traditions, laws and issues. A connectivity provider that can demonstrate such skills and understanding will be a key partner for firms navigating global trading.

Ultimately, the success of every bank and trading firm is dependent on its ability to build and maintain consistently reliable communications channels – regardless of whether those channels are used to sell, to inform or to trade. Electronic connectivity is not just a pipe for connecting to a market. Rather, it is a marketing and delivery channel for financial services.

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