

High Frequency Trading: System Reliability Makes or Breaks Financial Traders

Profits, reputation and market leadership rely on lightning fast systems, designed for extreme performance

EXECUTIVE SUMMARY

Speed is everything in financial markets. Orders transacted in milliseconds translate to real dollars for traders, with the winner of the race taking the prize. This is high frequency trading (HFT) or using complex algorithms to analyse and adjust to market conditions and execute smart, profitable trades in fractions of seconds. Because HFT solutions are some of the most sophisticated technical tools on the modern trading landscape, their uniquely intense performance requirements demand a closer look at how systems are tested, developed, integrated and deployed.

A QUICK PRIMER ON HIGH FREQUENCY TRADING

HFT is not new, although its role has advanced in step with global growth of financial trading. The process allows investors and fund managers to re-allocate portfolios within milliseconds of acquiring market information. Profits are earned or protected and the entire market benefits from systematic liquidity. HFT became widespread when major exchanges offered rebates as incentives for traders adding liquidity to the market. This is a source of profit separate from the trades themselves, where lightning fast trades capitalise on even the smallest adjustments in market conditions. These enticements have driven traders to recognise that, with the right compute power, they could create both profits and leadership.

DEFINING THE HFT SYSTEM

Trades that occur in the blink of an eye require a similarly fast system of interconnected technologies, transforming several best-in-breed products into one best-in-breed solution. With each product reliant upon the others, there is no room for lag time or performance glitches. The entire system must run like clockwork. But what does that ideal solution look like?

Sophisticated HFT systems consist of several components – switches, servers, network adapters, cables and software. These provide the functionality that can make or break the HFT process. Speed is at the core of the challenge and it is essential that these components work optimally—both independently and in collaboration—to reliably deliver data and execute decisions in microseconds. For the global financial exchanges that consider HFT solutions crucial to their business, this is what they must understand and embrace.

**World-class Performance**

Overclocked up to 5GHz with 18 Cores Active

**Greater Reliability**

New cooling subsystem delivers over 20% improvement

**Latency Optimised**

Optimised BIOS & Linux OS to deliver deterministic low jitter latency

**Greater Expandability**

Supporting up to 4 adapters – 2x double width FHFL + 1x FHFL

**Support and Warranty**

Local support partner network across Asia

PROCESSOR
Intel® Core™ i9-10980XE**MEMORY**
2 x 16GB DDR4-3200MHz**HYPER-SPEED FREQUENCY (CPU)**
Up to 5GHz**HYPER-SPEED FREQUENCY (RAM)**
Up to 3200MHz**CPU BASE FREQUENCY**
3.0GHz**CORES**
18 Cores Active**XENON: ONE STOP FOR TRADING INFRASTRUCTURE REQUIREMENTS**

Building on its long history and strong track record in high performance computing, XENON has become a 'secret weapon' of sorts, fueling the success of HFT firms worldwide. Tried and tested to real-world HFT operating conditions in the company's labs, the XENON eXtreme High Performance Trading Server line offers peak, reliable performance for customers across Asia Pacific, Europe and the Americas. Optimised to deliver more than 30% lower latency than standard off-the-shelf servers, eXtreme HFT servers extend a competitive edge to clients in an industry that demands 24x7 ultra-low latency – empowering market makers with maximum performance and return on investment.

While XENON's IP is built into its eXtreme HFT server, the company understands the server is just one element in crafting a complex, end-to-end HFT solution. XENON strengthens this world-class solution by incorporating innovative products into the system's design. These include SolarFlare networking solutions, Arista and Metamako switches, Exablaze switches and network interface cards, and Spectracom network time servers. By creating key alliances and partnerships within the high performance computing ecosystem, XENON is delivering servers that ensure a deterministic, low latency result with every trade.

Through its partners, XENON's systems include proprietary software designed for speed. For example, a customer using a standard Intel network adapter would experience latency of several microseconds, or a few thousand nanoseconds. Integrating optimised network cards coupled with an optimised software stack, XENON's systems would execute the same transaction within 700-800 nanoseconds. This is on the magnitude of a 3x or 4x difference, resulting in a 20%-30% faster execution than a server from a standard Tier One provider.

XENON servers are built, tested and customised for exchanges worldwide – designed to conveniently drop into any data centre infrastructure. Greater than the sum of their parts, XENON's solutions feature custom design of chassis, air flow, high-speed fans, CPU, memory, and more, with each component recognised as critical to assuring fast, reliable performance.

SMART OPTIMISATION STREAMLINES HFT PERFORMANCE

XENON adds unique value to the world of HFT transactions, optimising systems to streamline deployment for end users. Customisation includes hardware as well as a customised operating system (OS). Unnecessary OS components are stripped from the design, preventing any computing resources to be wasted on unnecessary processes. In stark contrast to a number of HFT solution providers, XENON servers are delivered as complete units, with minimum set-up and configuration required at the field level. Systems can be quickly racked and loaded with the user's application for fast and simple implementation. These optimisations are not additional chargeable services from XENON, but rather built into the company's deep and proven QA (quality assurance) operations.

QA DESIGNED TO PROVE EXTREME YET RELIABLE PERFORMANCE

Beyond engineering the server, XENON recognises that all equipment in the HFT solution is pushed to the limit of the manufacturer-recommended operating environment. While some HFT providers approach overclocking based on their ancillary experience, producing systems for gamers, XENON's expertise is centered on developing supercomputers – reliable, secure, overclocked systems specially designed to operate in a 24x7 environment.

These values are supported by XENON's QA process, in which the CPU is intentionally pushed beyond its comfort zone. Testing occurs over an extended period, typically one to two weeks of burn-in to validate reliable performance at speeds outside the CPU's recommended parameters. This enhanced QA process exceeds industry norms and places deeper value on understanding the HFT operating environment.

Overall, XENON eXtreme HFT servers are quality tested beyond the rigors of real-world HFT settings. For example, a hotter testbed environment is intentionally designed to push CPU core temperatures to an upper threshold, at least 5 degrees Celsius hotter than what it is typically found in a data centre setting. As a result, the XENON eXtreme server can be reliably overclocked up to 5.2GHz, with hyper-speed memory overclocked up to 4000MHz.

EVERY NANOSECOND COUNTS

In addition to overclocking concerns, users must consider latency or the end-to-end performance of the system from CPU execution to the network layer. XENON's servers already perform faster due to overclocking, and this is further improved with attention to reducing latency at the network layer. XENON works with its notable partners to optimise the network layer. Instead of CPU commands working through a traditional software stack, XENON's design bypasses the operating system kernel to increase speed of operations. Commands are sent directly to waiting CPU cores, unavailable to other processes and programmed solely to handle financial trades.

Details such as cabling also contribute to latency advantages. HFT firms are typically linking to financial centres worldwide, for example from New York to London. With signals traveling at the speed of light—or about four nanoseconds per kilometre—transactions can be processed as quickly as possible when they arrive at their destination. Smart cabling, with systems closely connected, eliminates any additional latency that could enter the process.

XENON's overclocked HFT servers can react **30%-50%** faster than competitors

IT'S ALL ABOUT RESPONSE TIME

One of the key factors for all HFT firms is how quickly they can respond to data and execute the trade. Improving latency, minimising jitter, eliminating networks bottlenecks across the entire network – all these are designed to perfect response times. The goal is to access technology that improves response times to the extent that they beat the competition in trading speed and excellence.

The HFT application must in turn be as efficient as possible, for example it must consider and optimise the different hierarchies of memory inside a server. Levels 1 and 2 are normally dedicated to a core inside the processor; Level 3 is a unified cache shared by all CPU cores; and Levels 4 and 5 start to jump across

the RAM to SSDs and similar options. HFT application developers must stay as close to the CPU as possible, working to keep their application footprint within the L3 cache size available in the CPU.

Minimising jitter presents a similar opportunity to address and perfect response time. Consider one packet traveling at 900 nanoseconds, and another at 1.3 microseconds... the larger the deviation between packets, the higher the jitter on the network layer. Stripping down the system to eliminate unnecessary computing operations is crucial in this scenario. Optimising the OS and BIOS ensures a jitter-free, deterministic environment focused purely on trading.

COMPETING ON THE COMPLEX FINANCIAL LANDSCAPE OF ASIA-PACIFIC

With a large footprint, local resources and global partnerships, XENON is the gateway to Asia for HFT users. It's a complex region that operates in stark contrast to the streamlined trading environment of North America with its New York and Chicago trading centres. For customers in the U.S. and Europe who want to trade in Asia, the business protocol is profoundly different, with traders working in a fragmented and diverse backdrop that includes Hong Kong, Singapore, Tokyo, Korea, India, Taiwan, China, and more. Different countries enforce different legislations. Much financial business is handled through brokers; as a result, traders are not in control of their own environment and must set themselves up to meet their country's regulatory standards. XENON's partner network simplifies these conditions, enabling investors and fund managers to trade easily and access local resources and support.

THE BENEFITS OF SMART, PROPRIETARY COOLING

It is common for each exchange or trading centre worldwide to have its own data centre onsite or co-located. These complex environments are often diverse in the technology they offer and operate,

with hundreds of racks running a spectrum of server configurations optimised for specific client processes. Their cooling solutions, however, tend to the traditional even though there are more suitable options. XENON's closed-loop proprietary cooling solutions are optimised for these environments, enabling cooling at the individual server level. Each server contains its own closed-loop proprietary cooling system which ensures efficient cooling, free of any infrastructure limitations presented by the data centre facility itself.

XENON's latest generation of eXtreme HFT servers also feature custom cooling fans, operating at exceptionally high speeds and designed to move more air through the system. The custom chassis further optimises thermal performance. Fans, cooling and custom chassis design all come together to support highly overclocked servers. Each offers performance value but, integrated in a smart design, these features significantly differentiate XENON's HFT solutions through thermal dynamics and physical design.

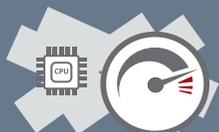
RELIABILITY IS EVERYTHING

HFT performance is uniquely demanding, with optimised solutions requiring a deep perspective on the technical challenges of global trading.

Supercharged processing asks a lot of the system itself, with transaction speeds that make all the difference in financial trading capabilities and profits. The underlying factor, however, is reliability. How much opportunity and reputation does a global trader lose when a server goes down? When transactions are completed in milliseconds, fortunes can be won and lost in a heartbeat. Uptime is the driving force behind HFT success, differentiating system providers and ultimately end-users as well.

Trading reliability and stability is at the heart of XENON's eXtreme HFT product line, built into its QA process, features and functionality, and partner network. High performance is not only proven, but also protected with unmatched attention to reliability as a system differentiator.

LOW LATENCY FOR THE WIN



Computational traffic is controlled by the operating system kernel. Low latency networking bypasses the kernel to move commands directly to the CPU for faster handling. This is achieved by allocating specific CPU cores for financial trades; they remain available and are not accessible to any other process. In addition to low latency enabled by OS kernel bypass, XENON considers the latency parameters of all components, for example the integrated switch. When properly equipped with enough buffer or memory, the switch can pipeline more instructions; without attention to latency here, the switch can cause a bottleneck by forcing instructions to enter memory and wait for execution.

For more insight on how XENON operates as an HFT infrastructure partner, please contact Sunil Khanna, XENON's Global Business Development Manager for High Frequency Trading & Financial Markets.

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