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ALGO TRADING SPECIAL
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ALGO-LOGIC SYSTEMS

TIME I$ MONEY

John W. Lockwood, PhD,
CEO

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> “ We help trading firms reduce latency in order to capture market opportunities

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By Vaisakh MS

The timescales for automated trading have changed. Decades ago, human market makers that traded in a few seconds were effective. But over many years, automated trading systems enabled computers to trade in milliseconds. Trading companies bought network interface cards that bypassed the operating systems, network engineers moved servers to co-located data centers, and software developers optimized code to execute trades in just a few microseconds.

Now, automated trading algorithms that had once been effective in software no longer generate alpha because a new breed of high frequency trading systems has emerged that uses logic instead of microprocessors to implement algorithms. These algorithms in logic run on Field Programmable Gate Arrays (FPGAs) and have fundamentally changed the speed at which trading systems operate.

Market makers and proprietary trading firms now use FPGAs to send orders to the market in response to market data with sub-microsecond latency. Likewise, broker-dealers enforce Pre-Trade Risk Checks (PTRCs) in FPGA logic to ensure market stability while only adding a few hundred nanoseconds to the latency of the trade.

"Achieving ultra-low latency is existential for profitable trading," remarks John Lockwood, CEO of Algo-Logic Systems, Inc. A few of the largest trading firms assembled armies of hardware engineers to build in-house trading systems. But now, FPGA-accelerated trading products are available from Algo-Logic as a standard product for all sizes of trading firms. With a dedicated team of computer architects, logic designers, engineers, and domain experts based in the heart of Silicon Valley, Algo-Logic Systems enables firms of all sizes to trade with sub-microsecond latency.

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> **Cost and time-to-market is minimized with a pre-built Tick to Trade (T2T) system**

Gateware Defined Networking

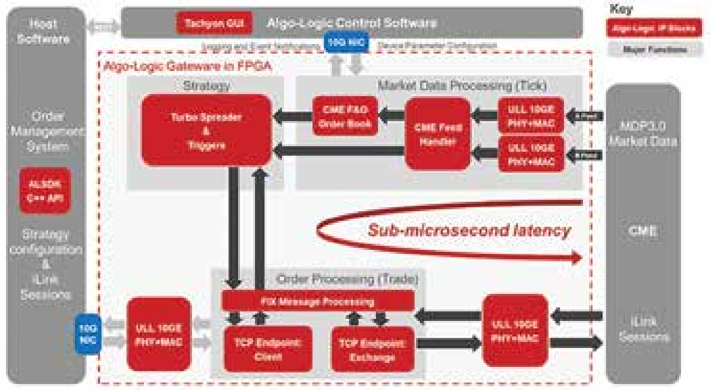
Algo-Logic has carved a niche for itself in the market. It specializes in mapping network algorithms into FPGA logic. It has developed a set of Intellectual Property (IP) cores to decode market data, maintain order books, trigger on events, modify fields, and send orders to the market with deterministic latency. The crux of Algo-Logic's technology is called Gateware Defined Networking (GDN).

According to Lockwood, firms that had been successful in the past with fast software are now losing in the market as they fail to roll out new technology that trades as fast as an FPGA. As large firms hired armies of engineers to implement High Frequency Trading (HFT) for competitive advantage, small-scale organizations and investors fell behind in profit because they lacked the required technology to compete. Algo-Logic enables firms of all sizes to overcome this challenge by providing best-in class GDN technology as pre-built products," states Lockwood.

Since its inception in 2009, Algo-Logic Systems, Inc. has evolved from first developing discrete IP cores, into next integrating these IP cores to GDN sub-systems, and now to providing complete trading solutions that include all of these technologies. Algo-Logic's T2T system leverages pre-built GDN that enables trading without the large expense, delays, and overhead of increased staffing or consulting fees.

Tick-to-Trade

Algo-Logic's flagship Tick to Trade (T2T) product is used on the Chicago Mercantile Exchange (CME) to accelerate trading of futures and options of equity indices, energy, bonds, and bitcoin. The T2T system is divided into three major blocks: the market data processing for the "tick", the strategy with triggers, and the order processing block for the trade. Algo-Logic has embedded all three of these blocks in logic that runs on a single FPGA logic device.



(Tick to trade image http://algo-logic.com/ticktotrade)

Starting at the top-right of the diagram, Algo-Logic's gateware performs several functions as data flows counter-clockwise through the FPGA. First, each tick of the market is processed by reading packets directly from 10 Gigabit/second Ethernet (10GE) ports using Algo-Logic's Ultra-Low-Latency Media Access Controller (MAC), feed handler, and order book processing module. Next, the strategy block implements policies that send orders to the market when pre-built triggers occur. Finally, orders are processed and sent to the exchange session via the Transmission Control Protocol (TCP) packets sent over the transmit side of another 10GE MAC.

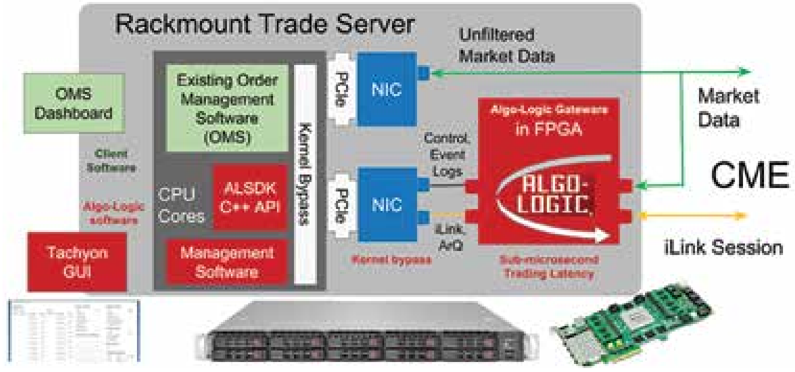
Algo-Logic's T2T product "bolts on" to existing OMS software to lower the latency for specific types of trades. Multiple pre-built triggers are already implemented in logic that instantly reacts to market opportunities by sending new, updating existing, and/or canceling open trade orders in FPGA logic. Because Algo-Logic has a full stack of order processing functions in logic, orders can be sent without a software delay. Fields in the order such as price and quantity can be rewritten in logic on the FPGA without waiting for the data to cross an I/O bus or be processed by a Central Processing Unit (CPU).

Deploying the System

FPGA logic fits in a device that resides on standard expansion card that fits inside a rackmount server. Algo-Logic partners with multiple vendors to provide pre-configured Linux servers that can be drop-shipped to co-located trading centers. As market data arrives from an exchange, Algo-Logic's gateware in the FPGA card responds by sending orders to the market within well under one millionth of a second. "The responses are sent directly from FPGA logic without having a CPU act as an intermediary, and that's why the latency of the system in unbeatable by software," Lockwood says.

Algo-Logic's system is designed to be friendly to software developers. Algo-Logic augments existing Order Management System (OMS) software with FPGA logic that provides the sub-microsecond trading capabilities. Non-latency sensitive trades simply pass through the system. Off-the-shelf Kernel bypass Network Interface Cards (NICs) from companies like Solarflare and Exablaze bridge between the CPU cores and the FPGA, allowing customers to run less-time critical trading software with few changes to their code.

Latency-sensitive trades are sent directly by the logic in response to time-sensitive market data. Customers just pre-load orders for execution and set parameters for triggers for the time sensitive trades. The parameters of these fast trades are controlled via the Algo-Logic Software Development Kit (ALSDK) C++ API. Algo-Logic's management software and optional Tachyon Graphical User Interface (GUI) can be used to configure and monitor the operation of the components inside the FPGA.



(Image of trade server http://algo-logic.com/tradeserver)

Success

Trading firms on the Chicago Mercantile Exchange (CME) approach Algo-Logic because they need help reducing their latency in their trading system. Once they realize that existing software-only trading approaches are no match for the firms already using FPGAs, they seek help migrating parts of their trading algorithms to logic. Algo-Logic's pre-built gateware components make it easy for these firms to deploy FPGA-accelerated systems without the cost and trouble of building an army of FPGA developers.

Market makers work with Algo-Logic to deploy spreaders in FPGA logic. Starting with the pre-built T2T system that has already been verified, synthesized, and tested, these market makers are able to deploy ultra-low-latency quoting systems without increasing the size of their team, training new employees to develop FPGA logic, or paying consulting fees. "Time-to-market matters when the time comes to upgrade from software to logic, and we have pre-built projects that make the process go quickly" explains Lockwood.

On equity markets, Algo-Logic works with broker dealers to optimize speed and performance for their compliance systems. Algo-Logic provides FPGA-accelerated logic that performs Pre Trade Risk Checks (PTRC) for equity orders as they flow between the trader and the exchange. With Ultra Low Latency PTRCs, brokers enable their customers to comply with SEC Rule 15c3-5 without the added latency of software-based order processing. As a result, these firms trade with almost zero added latency and jitter. By utilizing a full TCP offload engine that runs in FPGA logic, Algo-Logic ensures that the only packets sent to the exchange are compliant and intended to execute.

Typically, trading firms "bolt-on" Algo-Logic's FPGA solution to their existing Order Management System (OMS). But for option traders that rely on external software to manage their orders, Algo-Logic partnered with Rival Systems to provide a complete trading solution that includes both the prebuilt OMS software and FPGA-accelerated order processing. Together, the companies provide full-featured algorithmic trading software augmented with the FPGA for low latency.

The Future is Fast and Furious

Describing the company's expansion plans, the CEO divulges that they are leveraging gateware in domains beyond trading. In the datacenter, Algo-Logic's IP cores reduce the energy required to perform search functions, lower the latency of processing Ethernet packets, and completely offload the termination of TCP/IP without the overhead of software. Algo-Logic's Key Value Store (KVS) implements the function of a basic network-attached, in-memory database while being implemented entirely in FPGA logic.

In the physical world, Algo-Logic's Black Diamond system acquires real-time data from sensors to detect vibration, strain, energy flows, and other types of analog data. It records, precisely time-stamps, and streams data into the KVS much faster than can be done with embedded systems attached to a database in the cloud. Combined, these products provide complete end-to-end solutions for acquiring, fusing, and analyzing all types of live data. CM