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“FPGA-Accelerated Market Making for CME”

at the

STAC[®]	<i>High technology in finance</i>
SUMMIT	<i>New York / October 29, 2018</i>

Agenda & registration: www.STACresearch.com/events

ALGORITHMS IN LOGIC



[HTTP://ALGO-LOGIC.COM](http://ALGO-LOGIC.COM)

Trading Systems Have Evolved

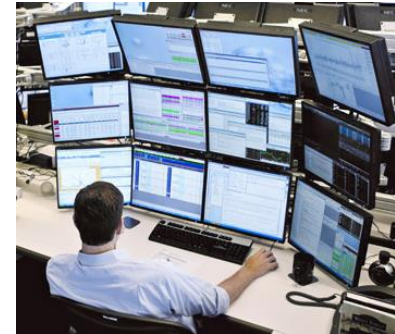
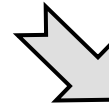
- **From Specialists in the pit**

- Trade on behalf of clients
- Make markets by buying and selling
- Trade in seconds to minutes (1 to 60 seconds)



- **To Software Trading**

- Automated trading using software from the desktop
- Trade in milliseconds to seconds (0.001 to 1 seconds)



- **To Optimized Software**

- Bypass the operating system kernel
- Run in servers at market co-Location datacenters
- Trade in microseconds to milliseconds (0.000001 to 0.001 seconds)



- **To FPGA-Accelerated Trading**

- Implement algorithms in logic
- Run on Field Programmable Gate Arrays (FPGA)
- Trade in nanoseconds using logic (< 0.000001 seconds)



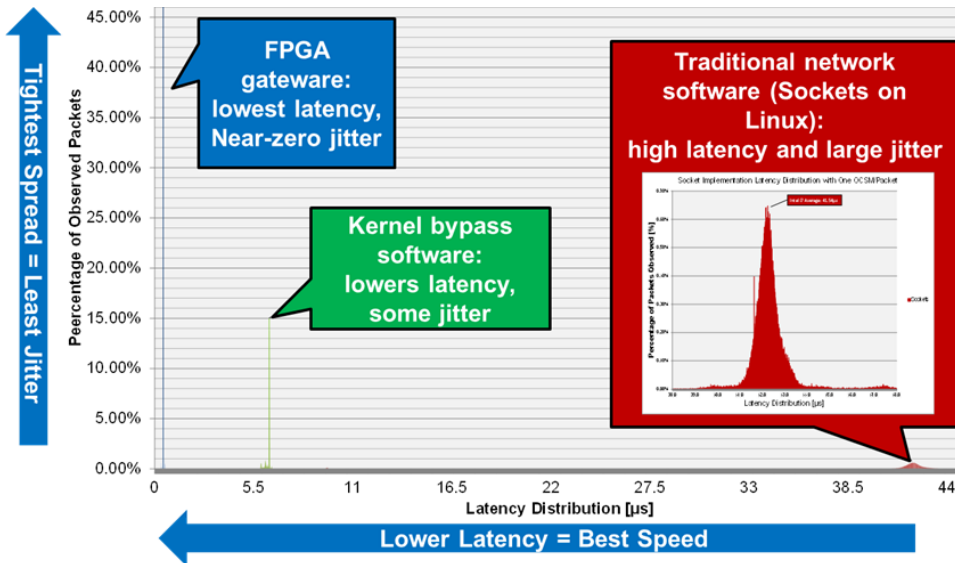
FPGA Acceleration Is the New Baseline for Successful Trading

- **Gateway vs. Software**

- Gateway is fast
 - Sub-microsecond Latency
- Gateway is deterministic
 - No jitter like software

- **Firms with Fast FPGA Trading Systems**

- Win most of the profits
- Use FPGAs to achieve fast Tick-to-Trade
- Consume raw, direct feeds from the market
- Instantly reacts to adverse situations



- **Firms with slower trading systems**

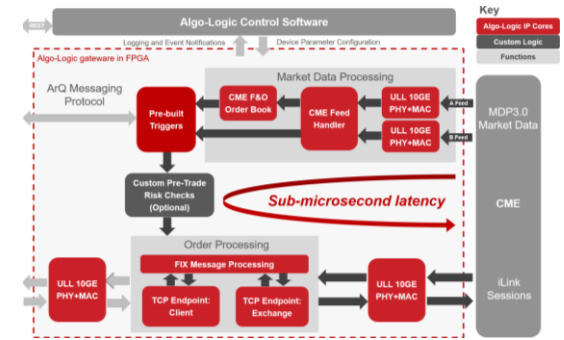
- Lose alpha
- Drop out of the market
- Respond more slowly to market changes



Algo-Logic's Tick-to-Trade (T2T) System

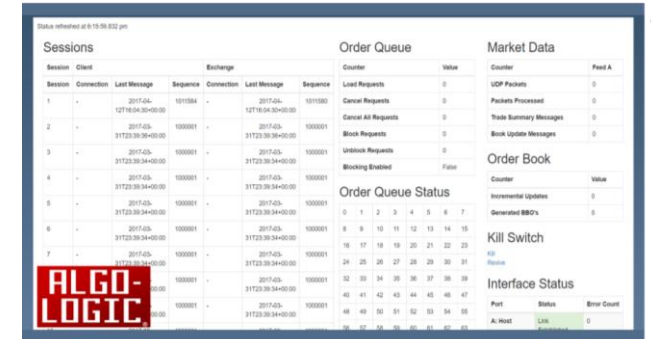
Algo-Logic provides FPGA Trading Solutions

- **Tick:** MAC, Market Data Parsing, Order Book
- **Trade:** Order Queues, FIX Processor, TCP
- Control and configuration
 - ALSDK C/C++ API interfaces
 - Viewable via Graphical User Interfaces



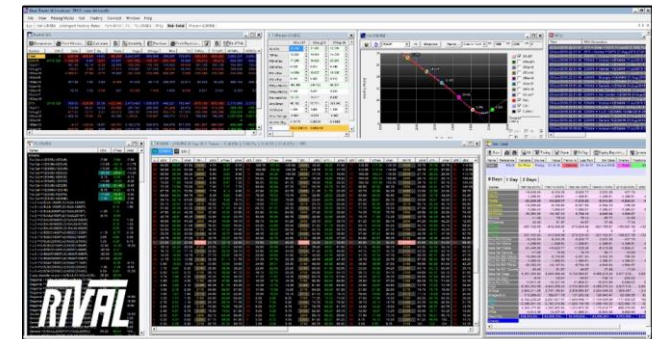
Interfaces to Existing Order Management System

- Standard network sockets for pass-through trading
- Application Programming Interfaces (APIs) to FPGA logic
- Minimal changes to existing OMS Software



Or Pre-integrated with Commercial OMS Software

- Works with off-the-shelf OMS software
- Accelerate trading of futures and options
- Available today through partnership with Rival

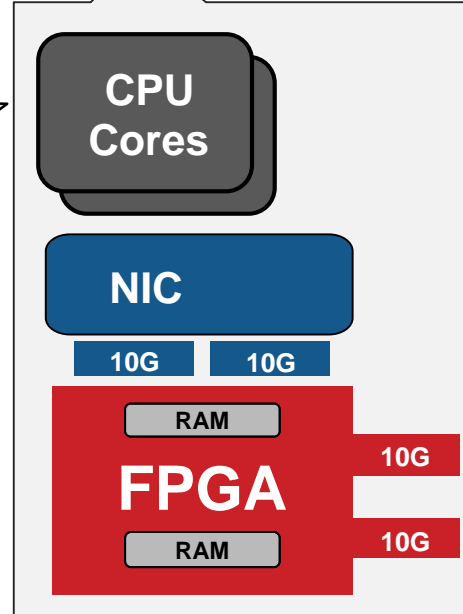
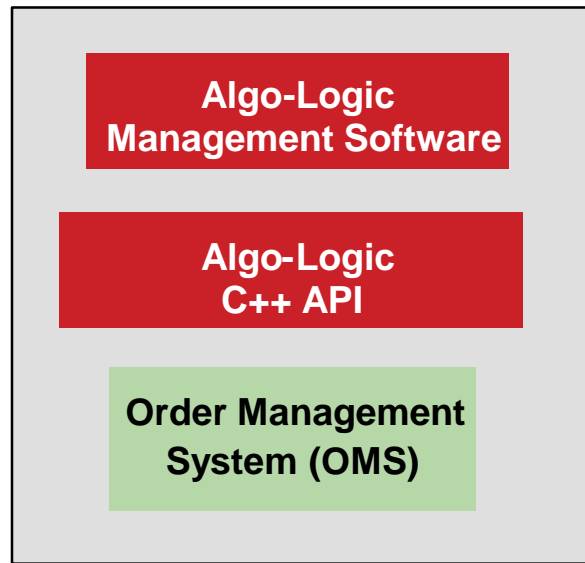
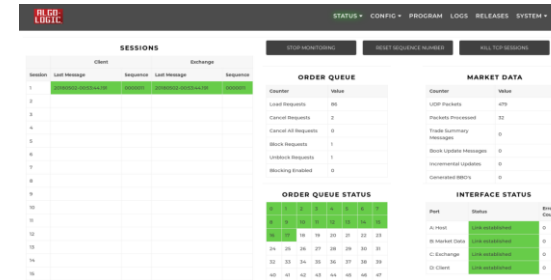


Algo-Logic's FPGA-Accelerated Tick-To-Trade System

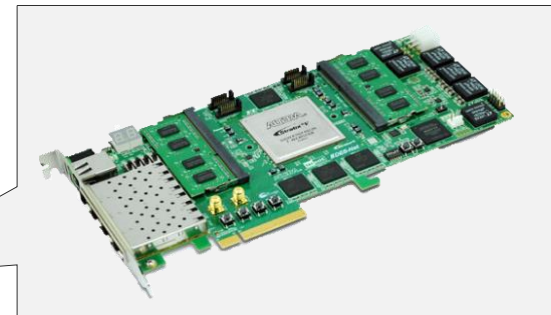
Trade Server



Algo-Logic GUI



FPGA Card

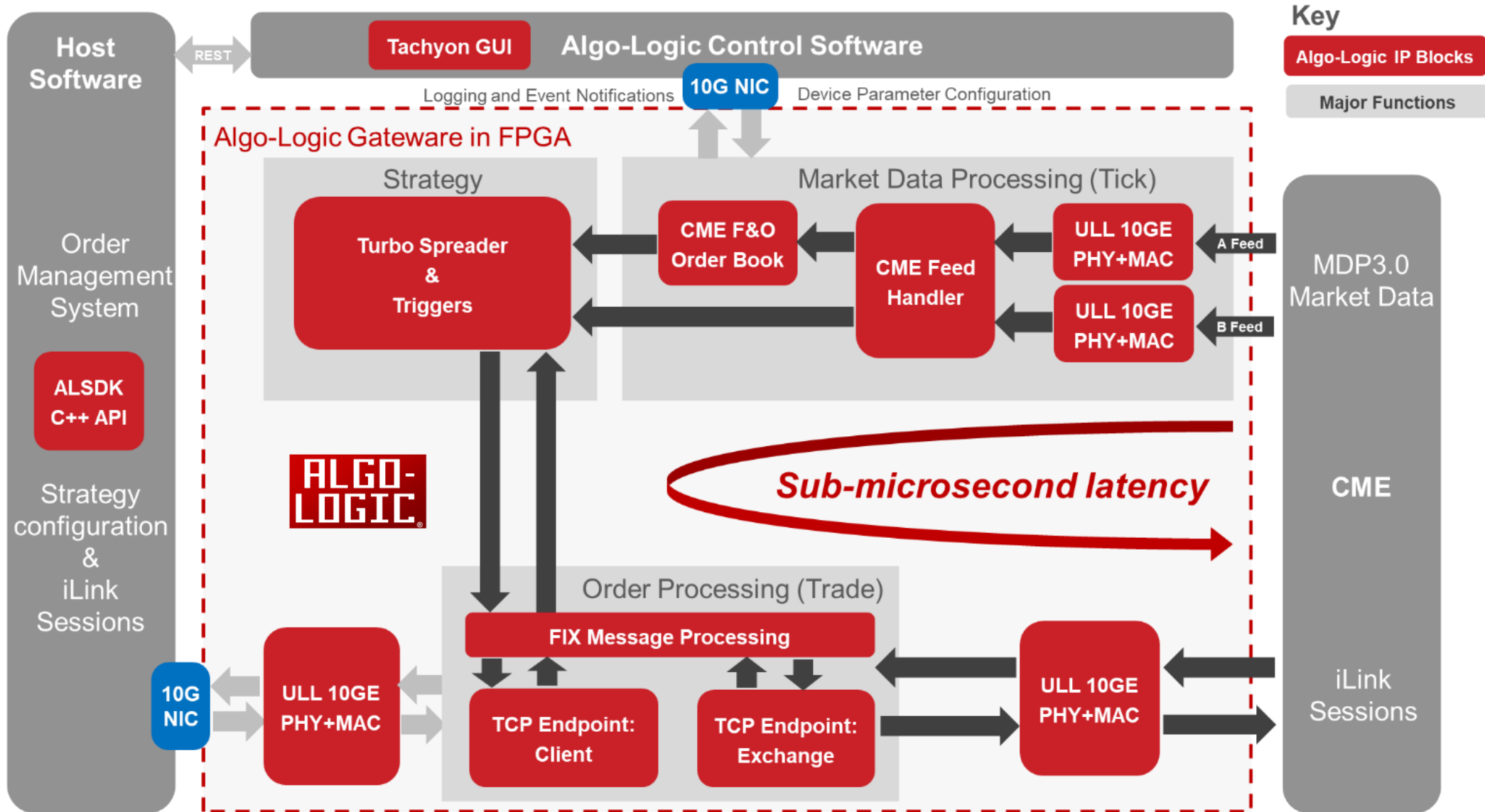


Exchange



10GE Links

Algo-Logic's Futures and Options Trading System in FPGA



Available for trading on all CME group markets (CBOT, COMEX & NYMEX). Supports futures trading of:



Algo-Logic's Trading Systems

Pre-built FPGA base systems for market making

- Achieves best-in-class trading latency
- Enables Quick Time-to-Market
 - No need to hire and train an army of Verilog developers

C/C++ Application Programming Interface (APIs)

- Interfaces to Existing OMS Software (in-house or commercial)
- APIs set up and control operation of pre-built FPGA modules

Web interfaces for initial control and configuration

- Easy to control and configure the FPGA
- Extensible RESTful APIs

Example: Algo-Logic's API to Accelerate Quoting in FPGA

```
finance::Spreader spreader; // Create spreader object
```

```
spreader.LeanParam1(securityID, priceMultiplier); // 1st Lean Leg parameter
```

```
spreader.LeanParam2(securityID, priceMultiplier); // 2nd Lean parameter
```

```
spreader.setTickSize(TickSize); // Quoting parameter initialization
```

```
spreader.setBidEdge(BidEdge);
```

```
spreader.setAskEdge(AskEdge);
```

```
// Pre-load Quote Bid and Ask order queues
```

```
spreader.setBidQuoteOrder(bid.queue, client, bid.ClientOrderId, SessionId, quoteSecurityId);
```

```
spreader.setAskQuoteOrder(ask.queue, client, ask.ClientOrderId, SessionId, quote.SecurityId);
```

Legs of the spread	CME Eurodollar Futures
Lean leg	GEM8
Lean leg	GEZ8
Quote leg	GEM8-GEZ8

Algo-Logic's Advanced Turbo Spreader

- **FPGA fires fast orders to market**
 - For quote cancel, and on fill triggers
 - Single API call to inject preloaded order
 - FPGA Logic can modify price, quantity, and order ID
- **FPGA computes price for quoting**
 - Leans on one or two legs of a spread (configurable)
 - Supports simultaneous quoting of multiple instruments
- **Supports CME products**
 - With up to 9 decimals of price precision
- **Auto-reload**
 - Enables multiple hedges and quotes to be sent using pre-loaded FIX order template

