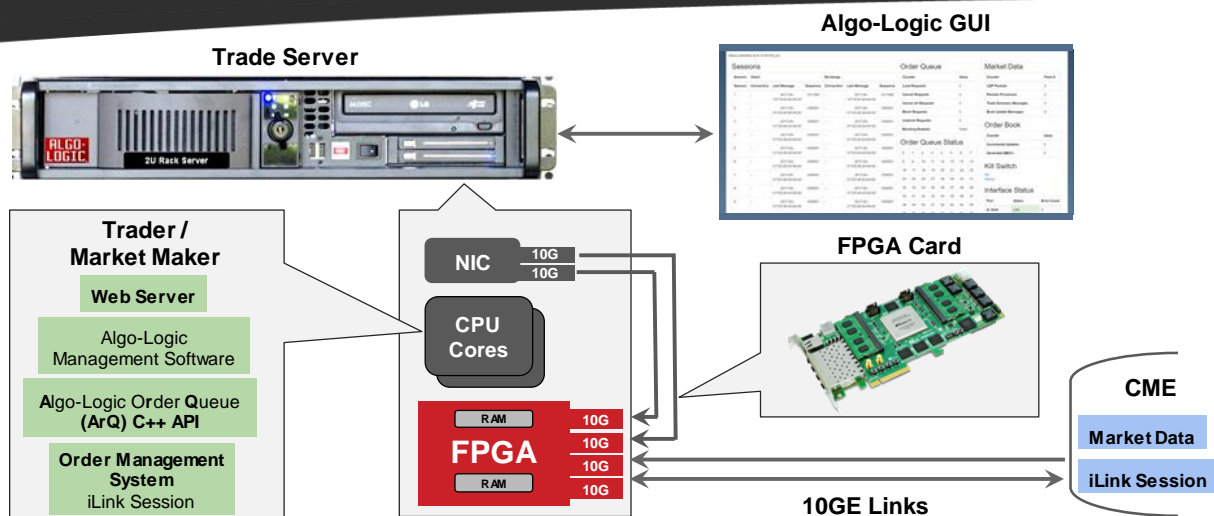


# FPGA Accelerated CME Tick-To-Trade System



## Description

Algo-Logic Systems' 3<sup>rd</sup> generation FPGA accelerated Gateway Defined Networking® (GDN) CME Tick-To-Trade (T2T) System is a sub-microsecond trading solution. The solution is built using Algo-Logic Systems' internally developed, pre-built IP cores that significantly reduce time-to-market and provide flexibility for customizations.

Sub-microsecond wire-to-wire latencies are achieved by receiving CME MDP 3.0 tick data directly into the FPGA on a 10G link, detecting opportunities, and placing trades in form of FIX messages encapsulated in TCP packets using the ultra low latency (ULL) 10G TCP Endpoint.

The CME T2T System consists of an FPGA card, Intel® CPU, and NIC. It seamlessly integrates with existing Order Management Systems (OMS) and is managed through software interfaces. An ArQ C++ Library, Graphical User Interface (GUI), and RESTful APIs are provided for control and monitoring of the accelerator.

### ArQ C++ Library and API:

- Low latency messaging protocol is used for specifying trigger conditions
- Sets up triggers and preloads FIX order to be injected

### Control Software includes:

- Device parameter configuration (i.e., IP and MAC addresses), status monitoring
- Logging and event notifications reporting

## Sub-microsecond Latency

Algo-Logic augments the existing Client Order Management System with FPGA modules that enable sub-microsecond trading.

### ULL 10GE PHY+MAC:

- Lowest round trip latency of 89.6ns
- Cut through packet processing

### CME Feed Handler:

- A/B faster feed arbitration resulting in earliest possible market data event detection
- Filtering on subscribed multicast channels
- MDP3.0 message processing and parsing

### CME Futures & Options Order Book:

- Book building for real and implied orders
- L2 snapshots with best bid offer (BBO) information
- Recovery based on CME Natural Refresh mechanism

### 10G TCP Endpoint:

- 100% FPGA accelerated full TCP termination
- Lowest packet processing latency
- Full TCP protocol support including fast retransmission

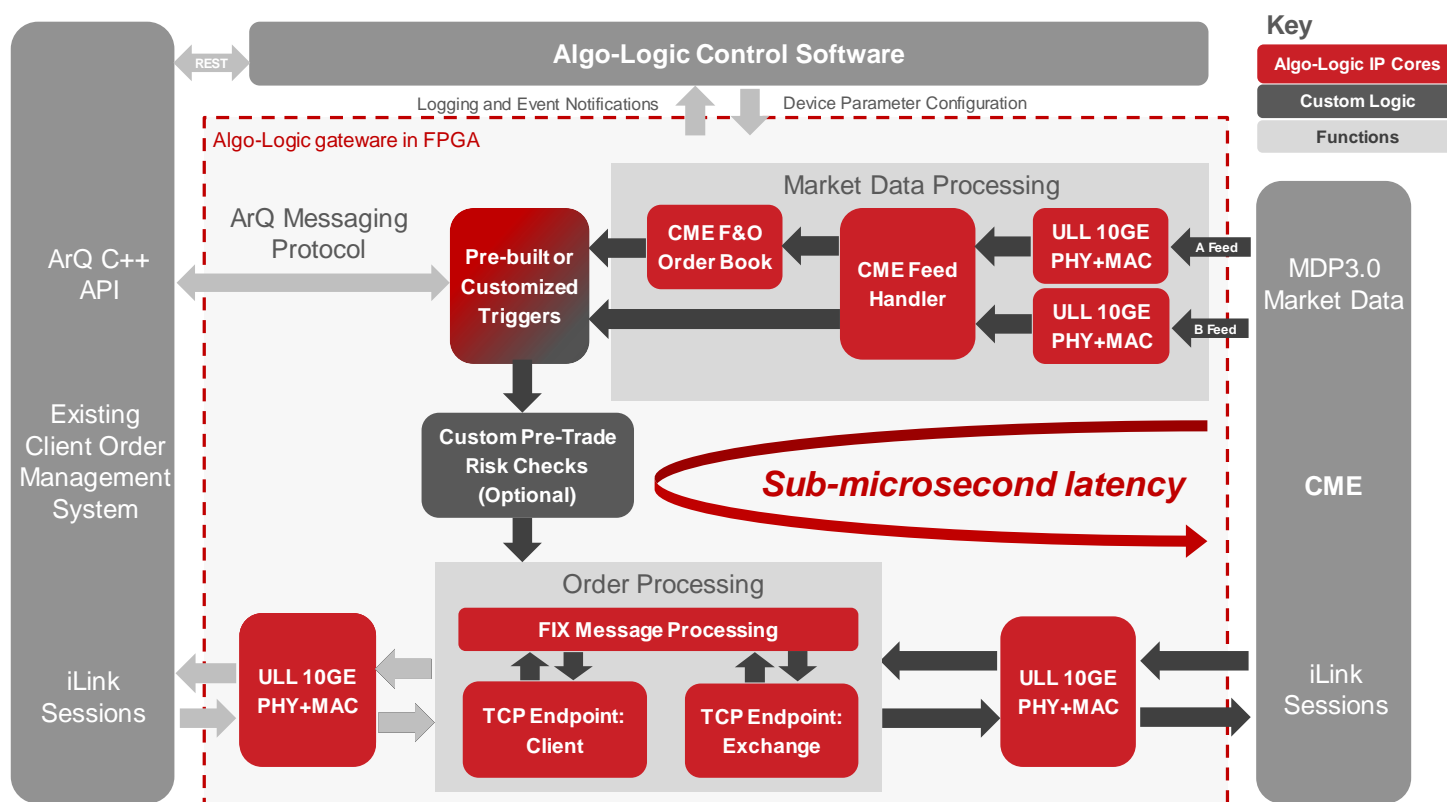
### FIX Message Processing:

- Session tracking
- FIX message processing and parsing

## CME Tick-To-Trade System Features and Base Specifications

<b>Multicast Channels</b>	Up to 16
<b>FIX Sessions and FIX Order Queues</b>	32 and 64 respectively, with 2 Kbyte per queue message size limit
<b>Pre-Built IP Cores</b>	CME Feed Handler, CME Futures & Options Order Book, 10G TCP Endpoint, ULL 10GE PHY+MAC
<b>Order Book Configuration</b>	20 security IDs with L2 snapshots containing BBO, all 10 book levels
<b>Trigger Types</b>	Quote Cancel, Security ID, Spreader Leg(s), Custom Triggers
<b>Pre-Trade Risk Checks (Customer Provided)</b>	Session based limits, Max Shares per Order, Order Value limits, and Number of Order limits
<b>Logging and Event Notifications</b>	FIX logs, Raw Market Data logs, CME Order Book BBO, Trigger events
<b>FPGA Device and Platform Supported</b>	Stratix V @ 10 Gbps Ethernet on Terasic DE5-Net

## CME Tick-To-Trade System Diagram



Algo-Logic Systems builds FPGA accelerated Gateway Defined Networking® (GDN) solutions that achieve high throughput with minimal power and sub-microsecond latency.