## **ALGORITHMS IN LOGIC**



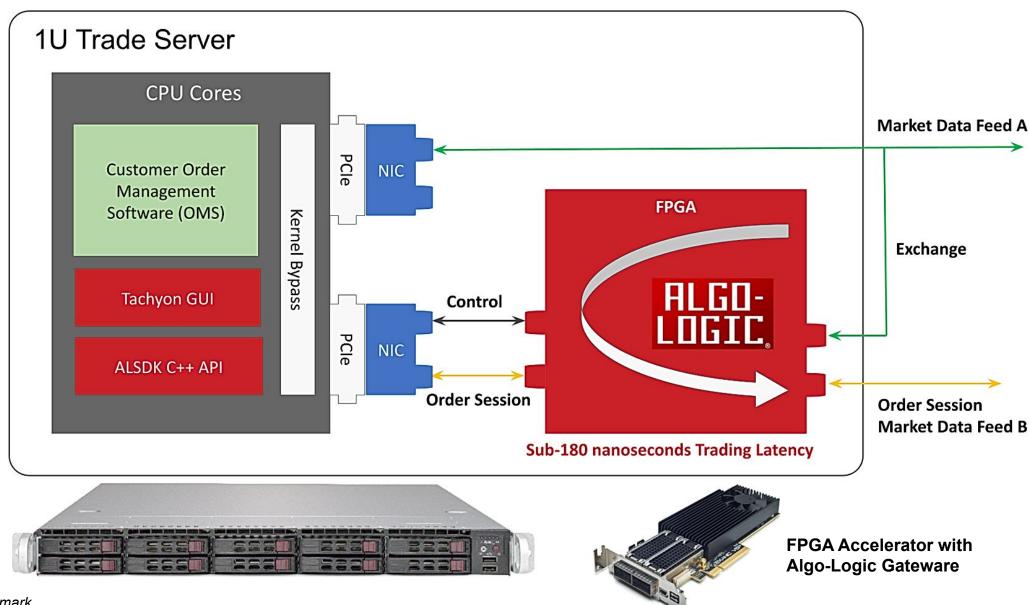
# Frameworks and solutions for Ultra-Low-Latency Trading with Algorithms in Logic

John Lockwood, CEO, Algo-Logic Systems, Inc.

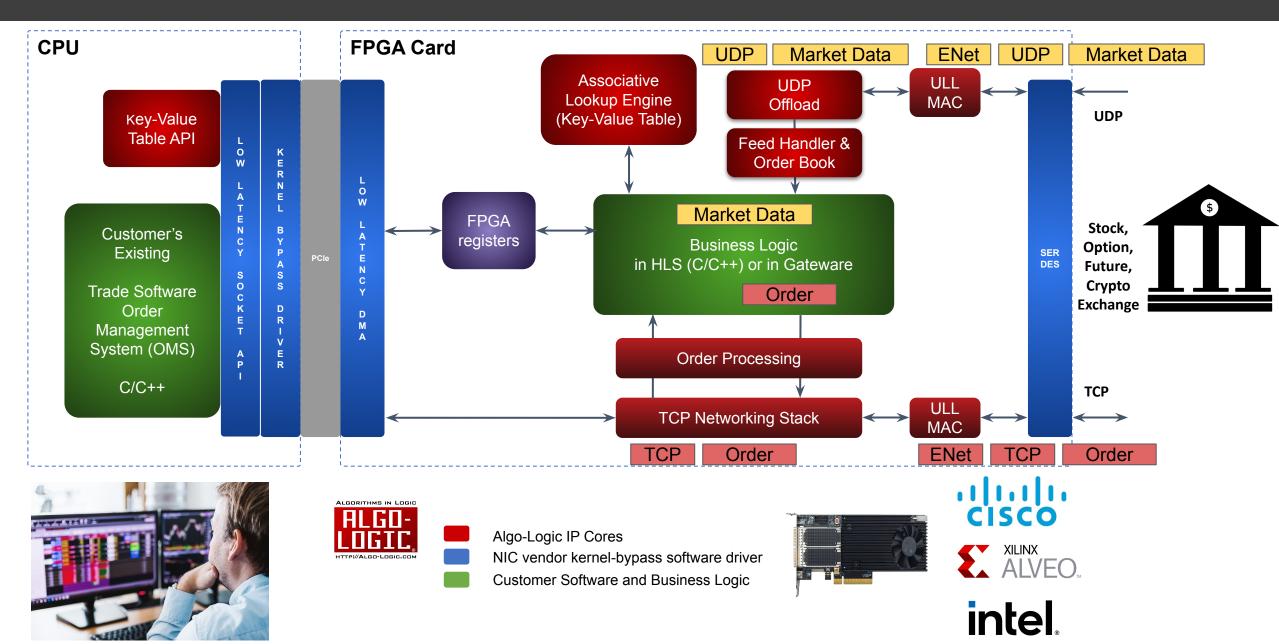
STAC: Spring 2022

Algo-Logic Systems Inc.

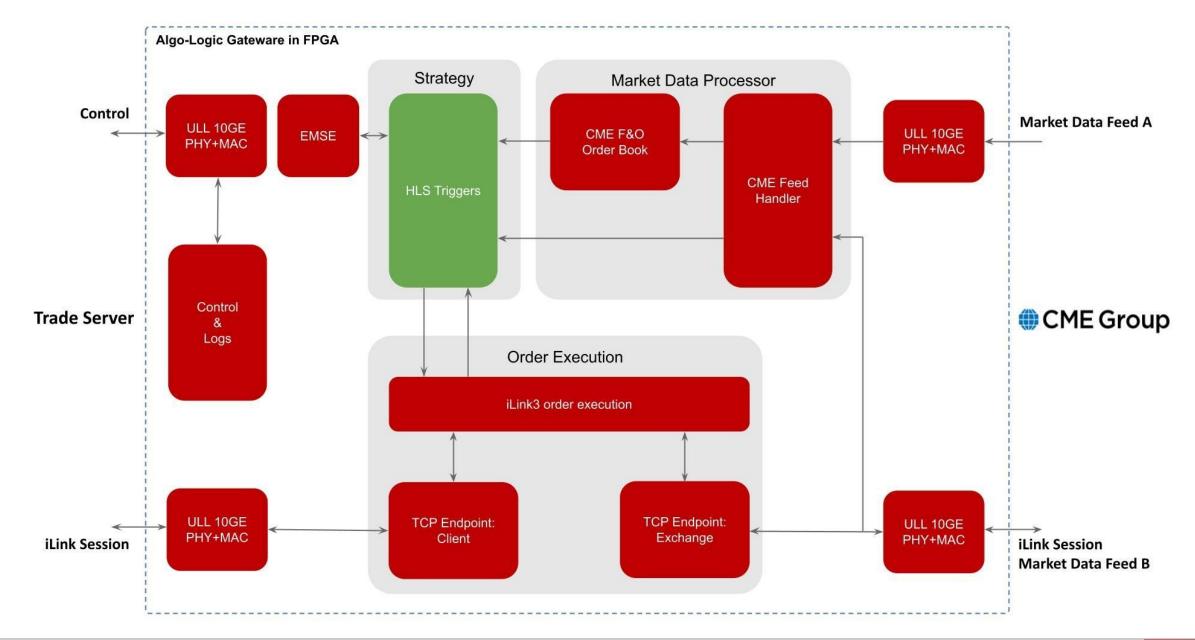
# **Acceleration of Trading with Logic**



# Algo-Logic Framework for FPGA-Accelerated Trading



## Algo-Logic CME Tick-To-Trade Framework - Example



# Algo-Logic Offerings, Products, and Customer Profiles

Complete FPGA accelerated solution

Development Framework

Complete Integrated Solution

Market Data
Tick-To-Trade
Pre-Trade Risk Check
Data Analytics

Multinational Investment Banks

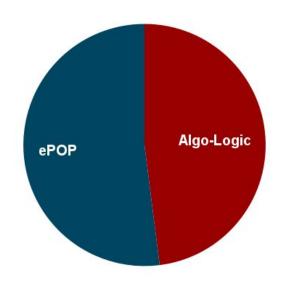
**Proprietary Trading Firms** 

Independent Software Vendor (ISV)

**Exchanges** 



# Algo-Logic / ePOP Customer Engagement Alternatives



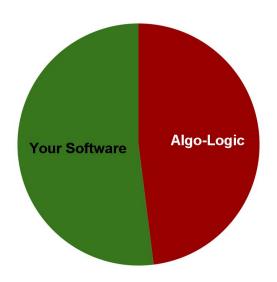
Integrated End-to-End Trading Solution

- For Trading Firms that do not have Trading Software
- Integrated Algo-Logic FPGA technology and FB Lab ePOP software in a fully integrated solution
- No software or FPGA development required



FPGA Accelerated Trading as a Service

- For Trading Firms that have Trading Software
- Connect to FPGA service via TCP
- Simple messages FIX format



Your Trading Software with Integrated FPGA Acceleration

- For Trading Firms with their own Software
- Integrate FPGA into your trading platform
- Continue to use your front-end and servers

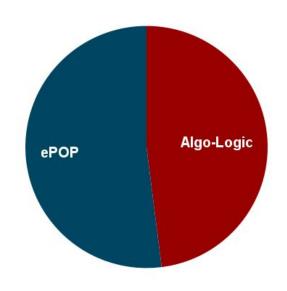


Customized FPGA Accelerated Trading Solution

- For Firms with Software and FPGA development experience
- Firms implement highly confidential proprietary strategies



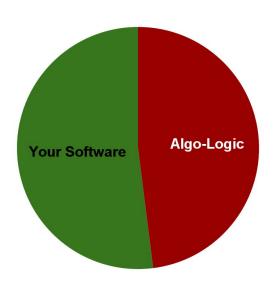
# Algo-Logic / ePOP Customer Engagement Alternatives



Integrated End-to-End Trading Solution



FPGA Accelerated Trading as a Service



Your Trading Software with Integrated FPGA Acceleration



Customized FPGA Accelerated Trading Solution

No Software Development No FPGA Development

Limited Software Development No FPGA Development Software Development Required Limited FPGA Development Software Development Required FPGA Development Required

Time to 1st Trade < 1 week

Time to 1st Trade < 1 month

Time to 1st Trade 1-2 months

Time to 1st Trade = 4-12 months



## Algo-Logic Technology Stack

#### Algo-Logic Building Blocks Ecosystem **Order Execution** - Session tracking FIX CME iLink3 Cboe/UBS/CS - Message modification - Message injection **Protocol Parsers** Credit Suisse - Per message processing **UBS Dark Pool** Cboe - Split message handling CME iLink3 Dark Pool **HKFE** FIX (BOE) (UBS ATS) - Extracting fields from messages (both (COUCH) inbound and outbound messages) **Market Data Protocol Parsers** A/B arbitration CME MBP CME MDP3.0 Choe PITCH Nasdaq ITCH Parsing Order Book - Price level order book Core building blocks 10G TCP/IP 10G UDP/IP **EMSE** - L3-L4 Network acceleration stack - Associative key-value lookup table Core building blocks 10GE - L2 Network acceleration stack **FPGA** 25GE Registers MAC registers MAC Platform Specific Interfaces (FDK) e.g. DMA, MMIO, OFF-CHIP MEMORY CONTROLLER, SERDES



# Client Describes Value of FPGA Acceleration?

## Client compare two trading systems:

- Software only, vs.
- Software plus Algo-Logic FPGA Acceleration

## Results

- Software system hit intended Hedge 53% of the time, while
- FPGA Accelerated system hit 95% of the time.

## With FPGA Acceleration

- Hit ratio on hedge improved 2:1
- And used more often and with larger quantities

# **Conclusions: Algo-Logic Offers Ultra-Low-Latency**

### Frameworks

- Algo-Logic technology stack
  - Core building blocks (ULL MAC, UDP, and TCP)
  - Market data parsers (MDP3, ITCH..)
  - Protocol parsers (iLink3, OUCH..)
  - Order execution (CME, Cboe, OUCH)
- Your customizable trading logic
  - Implement you own strategies in logic
  - Write your own C++ trading code with HLS

## Trading solutions

- Pre-built FPGA triggers
  - Quoting
  - Hedging
  - Spreading
- Pre-integrated with software
- Hosted at co-location for CME (Cbot, COMEX, NYMEX)
- On-boarding as fast as 1-2 days



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