



## Celoxica Accelerator for Market Data Capture

# Low-latency, high-capacity market data capture

### Key Benefits:

- Low-latency access to market data feeds
- High reliability during message spikes
- Minimal impact on heat and power consumption
- Plug-in improvement in performance of standard servers

Celoxica's Accelerator for Market Data Capture is the first product on the market to offer ultra-low-latency access to market feed data. With average latency figures below 10 microseconds, Celoxica is redefining the term 'low latency':

Celoxica leverages hardware acceleration to provide an innovative new architecture for market data line handling. This architecture gives high reliability during spikes in message volume. Integrated into standard, Tier 1 OEM servers, the Celoxica Accelerator for Market Data Capture offers the ultimate combination of performance and ease-of-use.

### Low-latency access to market data feeds

A co-processor FPGA directly connected to the network port means that the Accelerator can provide consistent low latency which is independent of the data volume. The high-speed link to the host CPU provides the lowest latency bus transfers available in standard servers.

- Hardware protocol stack (TCP, UDP, IP) – no overhead typically associated with software protocol stack
- Hardware FAST and ITCH decoders

### High reliability during message spikes

The innovative architecture of the Accelerator means that it can deal with fluctuating, high message volumes.

- Each Accelerator can process 4 saturated 1 Gbps Ethernet links with constant, low latency.
- The Accelerator provides consistent latency and reliability during message volume spikes
- Customised filters on the incoming data dramatically reduce the amount of data that the host CPU has to deal with

### Minimal impact on heat and power consumption

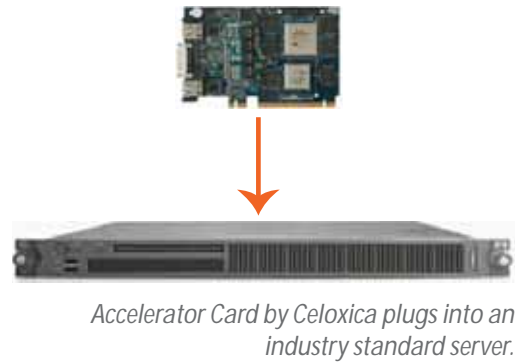
The low-power co-processor architecture means that even when processing four fully-saturated 1 Gbps network links, the total power consumption of the server is barely affected.

- Consumes ~15 Watts processing fully-saturated links

## Plug-in improvement in performance of standard servers

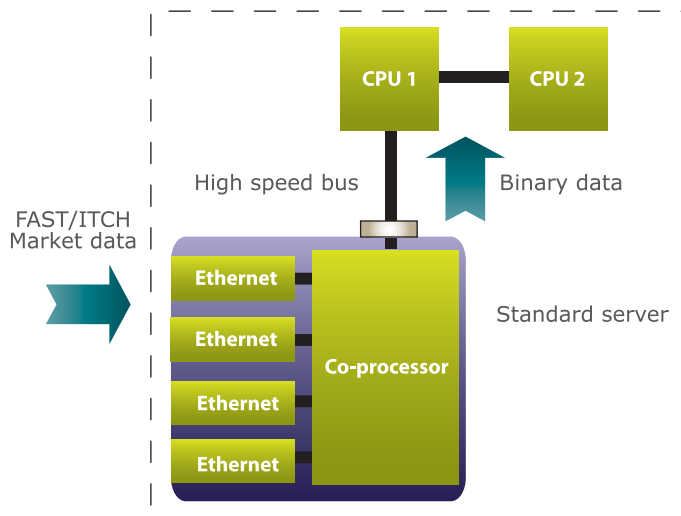
Simple integration into existing applications on standard servers, with the ability to customise the message interface.

- Qualified and supported by industry standard servers from HP and IBM
- Supported in standard, readily-available slot form factor
- Simple C/C++ API for integration into existing applications
- NIC emulation for diagnostics and integration into IT infrastructure



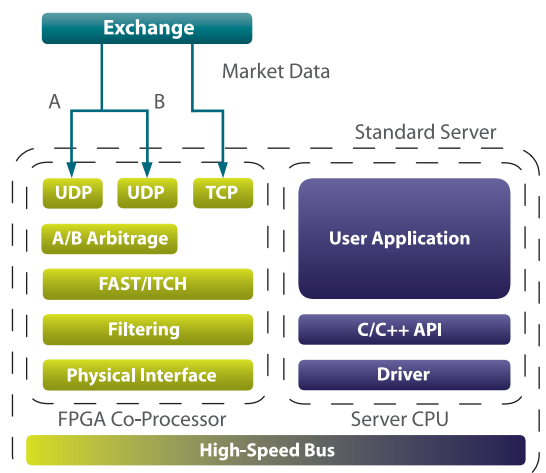
## An innovative architecture

FPGA co-processors have been discussed for a while in high-performance computing circles as a method for dramatically increasing system performance and offloading computation from CPUs. Celoxica's Accelerator is the first market data handler to directly connect a network interface to a co-processor, eliminating one of the major contributors to latency in a hardware/software co-processing system: the peripheral bus transactions between the co-processor and the network device.



Once in the co-processor, the network data is processed in a highly-parallel processing pipeline at line-speed. The TCP/UDP/IP protocol stack, A/B feed arbitration, FAST and ITCH decoders and message filtering based on customer-defined criteria are all implemented in dedicated hardware, with the lowest-possible latency.

The co-processor board fits into standard PCI Express (PCIe) or HyperTransport (HTX) slot which offer high-speed and low-latency interconnects. Once converted to a binary representation, the network data is transferred via the high-speed bus directly to the CPU's memory. A C/C++ API is then available for you integrate this system with your own application, getting feed updates before the competition.



## Supported market feeds

For each market, the Accelerator is configured with efficient co-processing logic tailored to that market feed.

- FAST-compacted, ITCH-based and ASCII market data feeds over UDP and TCP are supported
- Arbitrage between A and B feeds, where available, is performed in hardware
- ISE, OPRA, NASDAQ ITCH, CME, ICE, NYSE Arca are supported
- BATS, Eurex, Euronext, Xetra, Chi-X, Turquoise and LSE are coming soon

## Message Filtering

Rather than receive the full feed on the host CPU, you can define custom filters through a simple API, dramatically reducing the amount of data that the CPU has to handle.

- Define filters on the market data to get just what you need, minimising the load on your server
- Filter on variables including symbol, price, quantity and expiration date

## Deployment

The Accelerator Card fits into standard servers. The AMDC is available in single or multiple market deployments.

- Each Accelerator can process the full data rate of one market feed
- Each Accelerator-enabled server is usually deployed with a second server acting as a live-backup, taking over in the unlikely event of failure in the first
- A third server is advisable for testing and backup purposes

## Compatibility

- Windows Server, Solaris, Red Hat 5.0, Red Hat 4.0 (32 or 64 Bit)
- 2 to 4 Copper or Fiber 1 Gbps SFP modules supported
- PCI Express or HyperTransport slot
- Verified on HP and IBM servers with standard production BIOS
- Contact Celoxica for information on compatibility with other operating systems or servers

## Support, maintenance and professional services

- Front-line support provided by server manufacturer or their reseller through partnerships with Celoxica
- Second-line support provided by Celoxica
- A maintenance contract with Celoxica ensures timely access to the latest improvements and updates to the Accelerator
- Professional services to implement user-specific customisations

# Enabling Low-Latency Trading

## Overview

Increased competition, changing regulation and more pervasive electronic trading have resulted in a massive growth in market data and order traffic in the financial markets.

Trading firms and execution venues are adapting their trading architecture for ultra-low latency, removing unnecessary network hops, introducing co-location services, increasing market data distribution bandwidth and developing optimised software solutions on horizontally scalable, low cost server platforms.

## Challenges

- **Capacity:**  
moving from hundreds of millions to billions of order messages per day
- **Throughput:**  
moving from 100,000+ messages/second to millions of messages per second
- **Latency:**  
moving from milliseconds to microseconds

## Celoxica's solution

Celoxica's hardware-accelerated market data technology provides ultra-low latency, high throughput and consistent performance in all market conditions that will always outperform software-only solutions.

- **Ultra-low latency**
  - Faster response to market conditions
  - Under 10 microseconds from the wire to the user application.
- **Ultra-high throughput**
  - Access to all the data about the market
  - Up to 7 million messages per second sustained throughput from a single market.
- **Ultra-consistent performance**
  - Ability to trade through market data spikes
  - Consistently low latency, regardless of the spikes in market data volumes

## Clients

Celoxica's clients are interested in ultra-low latency trading and include large brokers, StatArb, algorithmic traders, proprietary traders and stock exchanges. Celoxica's solution is particularly suitable for high-frequency, low-latency applications in co-location setups.

## Markets

Celoxica products currently support OPRA, ITCH, ISE, ARCA, CME and ICE.

BATS, Eurex, Euronext, Xetra, Chi-X, Turquoise and LSE are coming soon.

## Performance-focused approach

Celoxica is focused on solving latency and throughput bottlenecks where it affects the trader, without radical changes to the organisation's infrastructure.

## Open Architecture

Celoxica uses standard APIs and supports the latest server and acceleration platforms through standard interfaces, for example PCI Express and the HyperTransport slot.

## Service

The service-based approach provides timely updates to software and firmware to support the latest exchange updates. This frees up clients' internal resources to produce proprietary, value-added applications.

## Flexibility

Clients can adopt as much or as little of Celoxica's solution as required. Celoxica can customise the solution to meet clients' needs and react quickly to changing requirements.

## Cooperation

Celoxica can integrate and collaborate with existing internal or third-party solutions. A growing array of partners allows Celoxica's technology to be deployed in a wide variety of infrastructure architectures.

## Roadmap

Celoxica's product roadmap continues to solve key latency and throughput problems in other parts of the trade lifecycle, with the same focused, open and cooperative approach. This means more partnerships, adopting the latest cutting-edge technology and solving critical problems.

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