FPGA Solutions for High Frequency Trading
Off-the-Shelf Altera Stratix® V FPGA Boards for Financial Application Acceleration

- Altera Stratix V: the industry’s highest performance FPGA with over 1 TeraFLOPS of processing
- 10GigE straight to the FPGA (no external PHY) for ultra low latency, saving hundreds of nanoseconds
- Maximum processing performance per watt
- PCIe-compliant deployable slot-cards for blade server systems
- Proven hardware that works out of the box, with validation, verification, and control software in place
- ATLANTiS FrameWork FPGA Development kit with proven, hardware specific IP
- Anemone floating point co-processor to accelerate performance and productivity (C-programmable, 24 GFLOPS per watt)
- Long standing COTS (Commercial Off The Shelf) vendor with a history of proven, successful, on-time supply

Financial Application Challenges
With high frequency trades being executed in microseconds, the ability to minimize the delay between market data arrival and issuing the trade is key. High frequency trading applications must account for a variety of challenges. These applications require ultra-low latency feed handling as well as ever-faster analysis/data correlation. They should also attain maximum performance per watt to minimize energy and thermal requirements. Many applications also require a scalable architecture to enable “FPGA Farm” implementation. BittWare offers FPGA-based PCIe COTS solutions to address the challenges of developing applications for the financial acceleration/HFT (High Frequency Trading) market.

BittWare Solutions to HFT Challenges
BittWare’s ultra-low latency hardware is based on the industry leading Stratix V FPGA from Altera and provides CPU offload, the highest performance transceivers, and optional TOE (TCP/IP Offload Engine). With maximum processing performance per watt to minimize energy and thermal requirements and 10GigE straight to the FPGA (no conversion to XAUI) for ultra-low latency, BittWare’s PCIe boards are ideal for applications in the high frequency trading market.

BittWare’s Stratix V PCIe cards offer the industry’s highest performance FPGA for network and algorithm acceleration. These boards are a robust solution for High Frequency Trading applications, providing the ultimate in low latency with high performance FPGA transceivers (no external PHY) and optional TCP/IP offload engine. By combining the Stratix V with the Anemone co-processor, BittWare’s board solutions enable partitioning of processing between software and hardware, making them ideal for implementing complex algorithms.
BittWare Hardware

Altera Stratix V GX/GS FPGA
The Altera Stratix V FPGA has been optimized for high-performance, high-bandwidth applications with integrated transceivers (up to 14.1 Gbps) supporting backplanes and optical modules. It supports 1.6 Tbps of serial switching capability and up to 3,926 18 x 18 variable precision multipliers, providing 1 TeraFLOPS of performance. The Stratix V provides an unprecedented level of integration with embedded HardCopy Blocks supporting PCI Express Gen3, and supporting configuration by PCI Express using the existing PCI Express link in your application. For additional integration, the Stratix V offers a variable precision DSP block optimized for FIR and FFT applications. The FPGA features an enhanced logic fabric with up to 925,000 LEs and 62 Mb RAM. And it offers flexibility with fine-grain and easy-to-use partial reconfiguration.

BittWare PCIe Hardware
BittWare offers a family of PCIe cards based on the high-bandwidth, power-efficient Altera Stratix V FPGA. BittWare’s S5 boards are a flexible and efficient solution for high-performance network processing, signal processing, and data acquisition. Combining them with BittWare’s Anemone co-processor and ATLANTIS FrameWork enhances productivity and portability and allows even greater processing efficiency.

BittWare’s PCIe boards offer:

- Multiple 10GigE connections straight to the FPGA: no separate PHYs for lowest possible latency
- Full support for PCI Express Gen 2 (x8 PCIe lanes)
- QDRII/II+ SRAM for lowest latency, DDR3 SDRAM for bulk storage, RLDRAM3 for low latency and storage
- Built-in support for 40GigE and PCIe Gen3
- Optional TCP/IP off-load engine (TOE)
- Fully validated, enterprise class, deployable boards

BittWare offers solutions for HFT to meet our customers’ specific requirements: a variety of memory types, including DDR3, RLDRAM3, and QDRII/II+; optional TOE; development environments; and the ability to customize products to your specific application. We currently offer Stratix V based PCIe boards in several variants:

- **S5PE**: Stratix V GX/GS x8 PCIe card with DDR3, VITA 57 FMC or dual QSFP+, and expansion site for Anemone co-processors
- **S5PHQ**: Stratix V GX/GS x8 PCIe half-size card with QDRII/II+, DDR3, QSFP+ and SFP+, and optional Anemone co-processor
- **S5PHR**: Stratix V GX/GS x8 PCIe half-size card with RLDRAM3, DDR3, QSFP+ and SFP+, and optional Anemone co-processor

FPGA Based Network and Algorithm Acceleration for Financial Trading

System Example 1
In this example, the FPGA in the customer’s high frequency trading application receives market data via 10GigE from the financial institution. The FPGA decodes, parses, and filters the feed; keeps the books; runs trade/risk algorithms; and manages orders. The CPU is used for system management. Orders are sent back to the financial institution via the FPGA over Ethernet.
**BittWare Firmware for Financial Acceleration**

BittWare offers firmware for the Stratix V FPGA on the S5 family PCIe boards, targeted specifically for high frequency trading applications. The firmware includes the following:

- 10GigE MAC
- Integrated IP for 10GigE TCP/IP Offload Engine (TOE) or UDP Offload Engine (UOE)
- PCIe multi-channel DMA engines
- DDR3, RLDR3, and QDRII/II+ controllers

**Tools and Support**

**System Development**

For system development tools, BittWare offers the BittWorks II Toolkit, which is a collection of libraries and applications for BittWare’s Anemone, Stratix IV, and Stratix V based boards. It provides complete hardware and FPGA interfaces, allowing customers to focus on application coding.

**Modified COTS**

We offer custom product and software design services for our customers, based on our Anemone FPGA Co-Processor and Altera FPGAs. Whether modifying an existing design from our extensive off-the-shelf product line or building a product to meet a customer’s exact specifications, our team can deliver a broad range of solutions.

**FPGA Based Network and Algorithm Acceleration for Financial Trading**

**System Example 2**

In this example, the FPGA in the customer’s high frequency trading application receives market data via 10GigE from the financial institution. The FPGA decodes, parses, and filters the feed; keeps the books; and runs proprietary analysis algorithms, while the CPU runs trading algorithms and performs order management processing. Orders are sent back to the financial institution via the CPU over Ethernet.
**FPGA Value-Add Products**

BittWare’s value-add products for FPGA ease development on our FPGA hardware and facilitate design portability and reuse, allowing our COTS boards to be ready to use off the shelf.

**ATLANTiS FrameWork FPGA Development Kit**

ATLANTiS FrameWork (AFW) is a library of FPGA components that includes preconfigured physical interfaces, infrastructure, and examples for BittWare’s Altera FPGA-based COTS boards. In a typical FPGA design, physical interface development can account for the majority of the development time; however, AFW saves months of effort by providing critical physical interface components that are tested and configured to meet the BittWare board’s specific requirements. To help further reduce development time, AFW includes many optional components for system IP, interconnect, and simulation and test. Working example projects for each supported board, which illustrate how to move data between the board’s different interfaces, along with full simulation and synthesis example projects allow customers to have a board up and running within hours. AFW includes all source code and is provided with our BittWorks II Toolkit.

**Anemone Co-processor for FPGA**

Any of our Stratix V FPGA boards can be equipped with the Anemone co-processor to accelerate your trading algorithms. The first generation Anemone chip, the Anemone104 (AN104) is a completely scalable, up to 750 MHz multicore processor with 16 cores that provide a total sustained performance of 24 GFLOPS while consuming only 1 Watt of core power.

Anemone is a truly C-programmable floating point compute engine that achieves superior power efficiency and processing performance by working alongside an FPGA as a co-processor. The FPGA handles all the memory, I/O interfacing, protocol processing, and special functions, in addition to any computational tasks it may perform. This leaves the Anemone free to efficiently perform complex processing tasks.

In addition to accelerating algorithmic performance, Anemone enables partitioning of processing between software and hardware, and it reduces system development cost by enabling out-of-the-box execution of applications written in regular ANSI-C. Ideal for implementing complex algorithms and for implementing processing with changing requirements, Anemone is a low risk and low power way to add processing resources.

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**Why BittWare?**

BittWare is a long-standing, ISO 9000 certified COTS vendor with a history of proven, successful, on-time supply to our customers, who include a number of Fortune 500 companies. Our hardware works out of the box, with validation, verification, and control software in place, allowing our customers to focus on their own expertise – their unique applications. We offer compatible hardware variants for alternate formats, functions, and technology upgrades, so developers can be creative and improve their system implementations without having to redesign components. The result is high-quality, reliable, deployed solutions with a quicker time to market and less risk.

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