DATASHEET

EnsembleSeries™ FCN8213

Rugged AdvancedTCA dual Xeon (Haswell) processing blade with FPGA acceleration

- **Dual Intel 1.8GHz 12-core Xeon (with Haswell architecture) server-class processors**
- **Up to 128 GB DDR4-2133 SDRAM**
- **Altera ARRIA 10 10 FPGA Co-processor**
- **4 QSFP+ fiber optic interfaces for sensor I/O streams**
- **40 Gb/s Ethernet or InfiniBand fabric interfaces**

The EnsembleSeries™ FCN8213 blade combines the general purpose processing capabilities of the EnsembleSeries HDS8613 with FPGA co-processing from an Altera ARRIA 10 FPGA device. By combining I/O, FPGA co-processing, and general-purpose Intel processing in a single AdvancedTCA® blade, the FCN8213 delivers a unique capability to the AdvancedTCA sensor and mission processing marketplace.

Dual Intel® Xeon® E5-2648L v3 x86 processors, each with 12 cores, the Haswell microarchitecture and the Wellsburg bridge (collectively called Grantley) and with the support of unrestricted 40Gb/s Ethernet and FDR10 fabric bandwidth, deliver scalable general processing power. The Altera ARRIA 10 FPGA delivers optimized FPGA co-processing capabilities. Four QSFP+ fiber optic interfaces support streaming I/O into the FCN blade. The optimized mechanical cooling technology ensures the highest blade and system MTBF even under full throttle, continuous processing conditions.

EnsembleSeries FCN8213 blades are part of Mercury's AdvancedTCA ecosystem of building blocks that includes 40 Gb/s Ethernet/InfiniBand switches and server-class general-purpose processing modules. These PICMG 3.0 compliant blades may be quickly configured and developed in the lab using concurrent engineering disciplines and deployed in industry-standard 2, 5, or 14 slot development chassis.

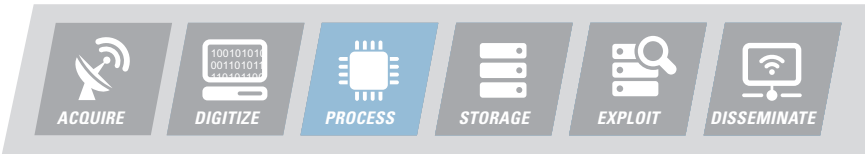
Mercury Systems is a leading commercial provider of secure sensor and safety-critical processing subsystems. Optimized for customer and mission success, Mercury's solutions power a wide variety of critical defense and intelligence programs.

Supporting Mercury's Xeon server-class ecosystem are Mellanox's Connect-X3 40Gb/s VPI interfaces, providing sufficient I/O bandwidth to exchange data with other modules in the AdvancedTCA system.

Mercury's FPGA co-processing and Xeon server-class AdvancedTCA ecosystem is the most powerful Open System Architecture (OSA) available for general processing, enabling true on-platform cloud processing at the tactical edge. Eminently suited to radar, electro-optical/infrared (EO/IR), complex image intelligence (IMINT), artificial intelligence (AI) and sensor fusion applications, this standard 8U AdvancedTCA form-factor blade enables compute capabilities that were never previously possible, adding new functionality and autonomy to modern missions.

FPGA-Based Pre-Processing

EnsembleSeries FCN8213 blades feature an Altera ARRIA 10 FPGA device with 4 QSFP+ interfaces to the front-panel of the blade and an additional four x4 I/O interfaces to the zone 3 user I/O region. This allows raw sensor data to stream directly into the FPGA, allowing for optimized pre-processing and co-processing algorithms to operate on the data before handing it off to the Intel general-purpose processing elements. The FPGA features 12 GB of DDR4-2133 memory in 3 banks to support co-processing operations, and is linked to the Intel Xeon processor complex by dual x8 Gen3 PCIe interfaces.



Xeon Server-Class Ecosystem

The EnsembleSeries FCN8213 features two Intel 64-bit Xeon (E5-2648L v3) 12-core processors. Each FCN8213 blade utilizes robust packaging to support two instances of high-pin-count land grid array (LGA) processors in a rugged, embedded form-factor. The dual 12-core processors are linked via two instances of the high-speed, low-latency quick path interconnect (QPI) interface, each with a 38 GB/s (bi-directional) data transfer rate, for a total of 76 GB/s of bandwidth between processors. This interconnected processor architecture is optimized for the intense data movement needed by high performance processing algorithms, such as all-to-all corner turn operations. From a software perspective, this QPI architecture allows the FCN8213 blades to be configured with a single kernel NUMA-aware operating system running across both processor devices.

Each processor is capable of delivering a 0.69 TFLOPS (peak), with four high-speed, 17.1 GB/s DDR4-2133 memory channels raw bandwidth each, for a total theoretical peak of 1.38 TFLOPS and 136 GB/s total raw memory bandwidth. The FCN8213 blades refines the innovative standing memory technology first seen on the 6U EnsembleSeries OpenVPX™ HDS6600, HDS6601 and HDS6602 to support up to 128 GB of DRAM on-board in a highly rugged configuration. Native Gen3 PCIe support is also featured on this processor, linking the processing resources directly to the I/O sources on the blade. The EnsembleSeries FCN8213 also makes use of the Wellsburg platform controller hub (PCH) chipset, which provides additional I/O bridging between the Intel processor and external devices.

Each Intel E5-2648L v3 processor includes a large 30 MB cache, shared between the cores, allowing many high-performance calculations to remain cache resident; this accelerates processing by eliminating the potential latency required to access DRAM to fetch upcoming data. The Haswell bridge family of processors supports the proven AVX2 instruction set, delivering an increase in floating-point algorithm performance that is portable to future Intel architectures. Each core provides the AVX2-capable fused, multiple-add (FMA) vector engine, which is especially valuable for radar processing applications, routinely requires the summing of vast arrays of multiplied numbers. The inclusion of FMA support enables complex radar and similar operations to be performed approximately twice as quickly as before. Fast Fourier transformations (FFTs) and other matrix manipulations are handled more efficiently with Intel's server-class memory and processing optimizations in the Xeon E5 processor family.

High Speed Fabric Interfaces

EnsembleSeries FCN8213 blades feature Mellanox's ConnectX-3 host adaptors for fabric channel communications. Bridging between the native Gen3 PCIe interfaces on the Intel processors and the AdvancedTCA fabric channel, the ConnectX-3 can be configured to support InfiniBand (DDR, QDR or FDR10) or 10/40 Gb/s Ethernet as the data protocol. This approach scales the fabric channel bandwidth to a peak theoretical rate of up to 5 GB/s per port, or 10 GB/s aggregate across the entire dual-port fabric channel. By scaling the fabric channel bandwidth to match the increase in processing performance, the EnsembleSeries FCN8213 architecture ensures that the processor is never starved for data.

System Management

The EnsembleSeries FCN8213 blade implements the advanced system management functionality inherent to the AdvancedTCA specification to enable remote monitoring, alarm management, hardware revision and health status. Using the standard IPMI-A and IPMI-B bus, intelligent platform management controller (IPMC), and IPMI protocol, the on-board system management block implementation is designed to comply with PICMG 3.0. This allows the EnsembleSeries FCN8213 blades to:

- Read sensor values
- Read and write sensor thresholds, allowing an application to react to thermal, voltage, or current variations that exceed those thresholds
- Reset the entire blade
- Power up/down the entire blade
- Retrieve blade field replaceable unit (FRU) information

AMC Mezzanine Configurability

EnsembleSeries FCN8213 blades bring additional I/O and/or storage capabilities to bear with their configurable AMC/XMC mezzanine sites. Capable of supporting any standard AMC or XMC module with ease, each FCN8213 blade is both powerful and configurable, with the ability for user customization built into the foundation of the product architecture.

Additional Features

EnsembleSeries FCN8213 blades provide all the features typically found on an avionics-class, single-board computer. In addition to the sophisticated management subsystem and fabric interconnect, each EnsembleSeries FCN8213 blade provides users with a toolkit enabling many different application features including:

- Thermal and voltage sensors integrated on-board
- Real-time clock with accuracy better than 10ppm <1second per day
- General purpose timers
- Global clock synchronization capabilities via utility plane clock signals
- Watchdog timer to support interrupt or reset
- Multiple boot paths, include netboot, USB boot, boot from SATA, or from the on-board flash device

Open Software Environment

Mercury leverages over 35 years of multi-computing software expertise, including multicore processor expertise, across its many platforms. This strategy is fully applied to the EnsembleSeries FCN8213 family of blades. The same Linux® development and run-time environment is implemented on the EnsembleSeries FCN8213 blade as on other Intel based Mercury modules across the EnsembleSeries 3000 and 6000 Series. Off-the-shelf open software such as OFED and OpenMPI are fully supported by the Mellanox ConnectX-3 fabric channel.

Mercury Sensor Processing Ecosystem

Modern sensor compute subassemblies are customized assemblies of interoperable building blocks built to open standards. Mercury's hardware and software portfolio of building blocks are physically and electrically interoperable as defined by international industrial standards, including AdvancedTCA.

Mercury's AdvancedTCA subsystems are designed from a suite of sophisticated open architecture building blocks that are combined and scaled to meet a broad range of advanced sensor chain processing requirements. Our subsystems may include analog, digital and mixed-signal receiver modules, single-board computers and signal processing payload modules. Payloads may have acquisition, digitization, processing, and exploitation and dissemination elements and include FPGA, CPU, GPU or ADC/DAC technology.

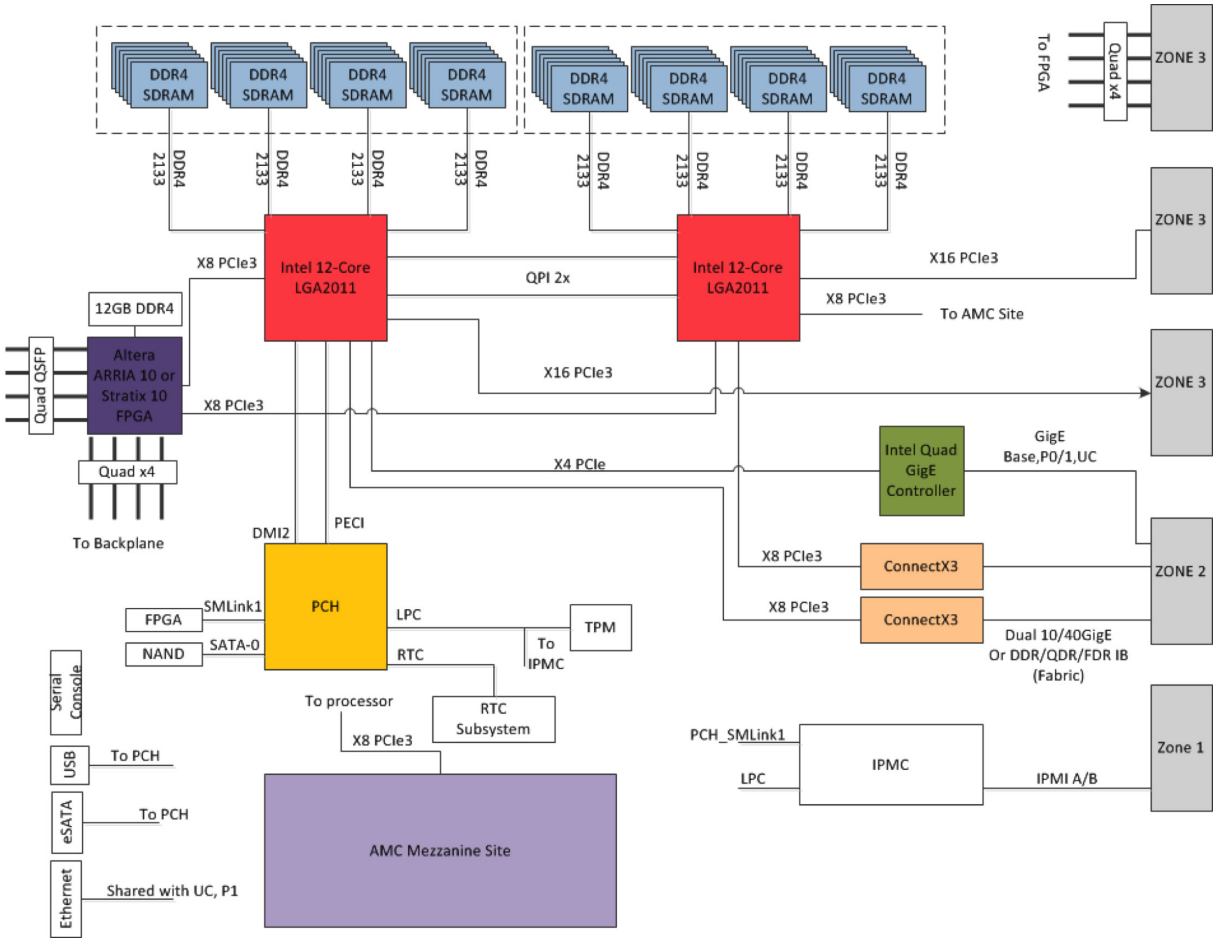


Figure 1 - EnsembleSeries FCN8213 Functional Block Diagram

Specifications

Processors

Dual Intel 1.8GHz 12-core E5-2648L v3 (Wellsburg Bridge) Xeon server-class processors

- Haswell architecture with Fused Multiple-Add and AVX2
- Peak performance 1.38 TFLOPS per blade
- Threads per core 2
- QPI interface between processors
  - 38 GB/s bi-directional (76 GB/s between processors)
- Dual Integrated x16 Gen3 PCIe interface

FPGA pre-processor

- Altera ARRIA 10

Memory

Xeon processors:

- Up to 128GB DDR4-2133 with ECC

FPGA Pre-processor

- 12GB DDR4-2133

BIOS

SPI flash: Dual 16 MB partitions

NAND flash: 8 GB, SATA interface

Fabric Channel

Mellanox ConnectX-3 VPI host adapter

Support DDR/QDR/FDR10 InfiniBand or 40 Gb/s Ethernet protocols

Mechanical

8U AdvancedTCA PICMG 3.0

1.2" slot pitch

Power consumption

- ~75W per processor
- ~250W per module

Environmental

		Standard ATCA Product Environmental Qualification Levels	
Cooling Method		Air-cooled	
Ruggedness		ATCA Rugged Level A1	ATCA Rugged Level A2
Temperature	Operating*	0°C to +40°C	-5°C to +40°C
	Storage	-40°C to +70°C	-40°C to +85°C
Humidity	Aggravated	10-95%, non-condensing	
Altitude	Operating*	0-10,000ft	
	Storage	0-30,000ft	
Vibration	Sine	0.5G Sine, 5-100 Hz, .25 Octave/min, 1 hr/axis	1G Sine, 5-100 Hz, .25 Octave/min, 1 hr/axis
	Shock	z-axis: 10g; x and y-axes: 10g; (11ms ½-sine pulse, 3 positive, 3 negative)	z-axis: 10g; x and y-axes: 30g; (11ms 1/2-sine pulse, 3 positive, 3 negative)
Required Flow Rate		Contact Factory	

* Customer must maintain required cfm level. Consult factory for the required flow rates. Reduced max ambient operating temperature or increased airflow may be required to maintain full ooperation at altitude.

Additional Services	
Optional Environmental Screening and Analysis Services	Standard Module, Optional Services
• Cold Start Testing • Cold Soak Testing • Custom Vibration • CFD Thermal Analysis • Finite Element Analysis • Safety Margin Analysis • Temperature Cycling • Power Cycling • Environmental Stress Screening	• Engineering Change Order (ECO) Notification • ECO Control • Custom Certificate of Conformity (CofC) • Custom UID Labeling • Alternate Mean Time Between Failure (MTBF) Calculations • Hazmat Analysis • Diminished Manufacturing Sources (DMS) Management • Longevity of Supply (LOS) • Longevity of Repair (LOR)
Contact factory for additional information	

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