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The APOLLO ATCA Platform

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We have developed a novel open-source Advanced Telecommunications Computing Architecture (ATCA) platform - APOLLO - which simplifies the design of custom ATCA blades by factoring the design into generic infrastructure and application-specific parts. The APOLLO “Service Module” provides the required ATCA Intelligent Platform Management Controller (IPMC), power entry and conditioning, a powerful system-on-module (SoM) computer, and flexible clock and communications infrastructure. The APOLLO “Command Module” is customized for the application but typically includes one or more large field-programmable gate arrays, several hundred optical fiber interfaces operating at speeds up to 28 Gbps, memories, and other supporting infrastructure.

Summary

The APOLLO platform provides a relatively simple hardware environment and firmware and software toolkit which can be used for the development of ATCA blades. The development of high-performance ATCA blades for high-energy physics applications has proven to be quite challenging. Many problems must be solved, including: The delivery of adequate power (up to 400W in some cases); cooling to remove the resulting heat; high-performance communications interfaces for control, monitoring and data acquisition; optical fiber management; and industry-standard debug and programming interfaces for routine monitoring and recovery of “bricked” modules.

`The APOLLO Service Module is a standard-size ATCA blade with a`

7U x 180 mm cutout to accommodate one or two Command Module boards. The Service Module design is quite conventional and uses standard commercial power entry and conditioning modules, delivering 12VDC at up to 30A to the Command Module(s). A CERN, Wisconsin or other compatible IPMC in an SODIMM package can be accommodated. The IPMC sensor bus is routed to several sensors on the Service Module as well as to the sensor tree on the Command Module. Joint Test Action Group (JTAG) master capability may be provided by the IPMC for diagnostic purposes or reprogramming of the SoM as well as Command Module programmable logic.

`The demonstrator APOLLO Service Module accommodates a commercial`

Zynq SoM which runs an embedded version of the Linux OS. The module contains 1 GB of system memory, 512 MB of flash and a micro secure digital (uSD) card interface. Flexible on-blade interfaces are provided, including: Front-panel gigabit Ethernet, an additional

Ethernet to the switch; four 10 Gbps bidirectional serial links to the Command Module, asynchronous serial and Inter-Integrated Circuit (I2C) interfaces to the IPMC and Command Module as well as JTAG master/target capability.

A firmware and software reference design is provided for the

APOLLO platform to allow new users to become quickly productive. A set of Advanced eXtensible Interface (AXI) peripherals are included to provide convenient access to the on-blade interfaces. A complete Makefile and script-based build environment supports easy customization of the Zynq system using a pure text system description which integrates well with repositories and version control systems. A reference software system provides access to all hardware features using the IPbus software suite.

Anticipated applications for the APOLLO platform include: The

Level 0 trigger for the monitored drift tubes (L0MDT) in the ATLAS experiment; the data acquisition and timing card (DTC) for the inner tracker and the track finder for the CMS experiment. All hardware and firmware of the APOLLO is open-source to the extent permitted.

The APOLLO demonstrator hardware will be presented, along with test results and a brief description of each of the currently planned implementations.

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