xTCA-COMPLIANT PCIe HUB/CONTROLLER FOR PHYSICS CODAC

SUBSYSTEMS

M. Correia, J. Sousa, A. P. Rodrigues, A. Batista, B. Gonçalves, C. A. F. Varandas

Instituto de Plasmas e Fusão Nuclear – Laboratório Associado, Instituto Superior Técnico,

P-1049-001 Lisboa

Corresponding author: mcorreia@ipfn.ist.utl.pt

Fusion plasma devices require highly complex Control, Data Acquisition and Communications (CODAC) systems due to ever-increasing demands on loop-cycle time, data bandwidth, channel density and failure prevention.

The Advanced Telecommunications Computing Architecture (ATCA) specification has already proven to be a successful solution for real-time multi-input-multi-output (MIMO) architectures, and provides important non-functional features such as hardware management, fail-safe and redundancy. xTCA builds up from ATCA, standardizing timing signaling and port assignment on the Rear Transition Module (RTM), which are important features for instrumentation.

Continuing the development efforts on ATCA instrumentation for CODAC systems for fusion devices, the authors designed an improved, xTCA-compliant, PCI Express-based, switch/AMC (Advanced Mezzanine Card) carrier module. Switching is carried out by a PCIe Gen 2 Switch (PEX 8696) and links to all existing nodes within an xTCA shelf, in a redundant dual-star topology. Timing distribution for the AMC modules, RTM and xTCA backplane is implemented on a Xilinx Virtex 6 Field Programmable Gate Array (FPGA).

Each module can carry up to four AMC and one RTM, up to 70 cards interconnected through a PCIe network. Therefore, the hardware will be able to perform a vast range of functionalities, such as data acquisition, processing, storage or signal generation, by inserting appropriate RTM and commercially available AMC modules, making them suitable for MIMO control of fusion devices.

This paper presents the detailed hardware implementation, technology and layout of the module, as well as the preliminary tests.