FUSION FOR ENERGY

TECHNOLOGY OFFER

HotRIO Ecosystem: High-Performance, Low-Latency control systems with modular distributed I/Os and proprietary fibre protocol

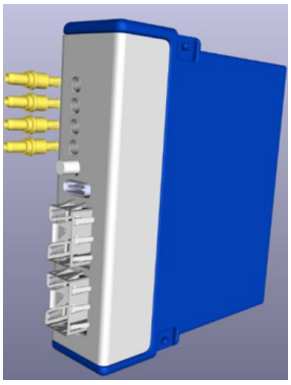
F4E has developed a specific communication protocol based on physical layer of 1Gb Ethernet over fiber for real time applications where low latency, timing synchronization and immunity to EMI is required. Together with the deterministic protocol, a series of hardware modules based on FPGA processors and different I/O interfaces have been developed to offer a complete a modular control system. The system integrates extensive distributed I/O capabilities (up to hundreds), ultra-low latency, and high processing power.

The technology

The HotRIO protocol is based on the physical layer of 1Gb Ethernet over fiber, providing high availability of hardware components at reduced cost. Unlike traditional Ethernet protocols (UDP, TCP/IP), which often operate on shared-resource computers and lack consistent transmission timing, HotRIO achieves deterministic latency due to its FPGA-based processing. With FPGA latencies in the microsecond range, HotRIO bridges the performance gap between PLCs (typically tens of milliseconds) and servers or fast controllers (usually in the millisecond range) and it goes beyond. Additionally, it includes timing flags for synchronization of all nodes connected in the HotRIO chain.

Filling the gap between PLC and Fast Controllers/Servers

Planned HotRIO HW modules are based on low-cost FPGAs for standard applications (Lattice ECP5-5G) and large FPGA for higher-demanding applications (Xilinx Ultrascale). Additional IO modules connected to the FPGA boards via fiber (HotRIO protocol), or backplane have been also developed to interface with standard industrial components like PLCs (isolated digital IOs, RS232/485), network switches (UDP, TCP/IP), sensors (ADCs) and actuators (TTL, 24V, DACs). Depending on the user-application, the format of these modules can be either stand-alone, euro-card format (10 cm x 17 cm) or compatible with cRIO chassis from National Instruments. The modularity of this HW boards offer extreme flexibility and scalability to the different needs of each control system.



Collaboration opportunities

F4E makes the HotRIO technology available to companies for their use and commercial exploitation through open-source and open-hardware mechanisms. The first HotRIO HW modules and HotRIO protocol have been fully designed, manufactured, and tested. Control Systems based on HotRIO technology meet the particularities of many fusion applications that cannot be solved with standard industrial solutions. On the other hand, the use of standard and low cost of HotRIO may convert this technology into a good candidate for more exigent control system requirements in industries such as aerospace, automotive, oil and gas, pharmaceuticals, and renewable energy, where precise, reliable, and scalable control systems are essential.

Fusion for Energy Technology Transfer Programme

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