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IRIO Technology: developing applications for Advanced DAQ systems using FPGAs

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IRIO Technology is a set of software tools together with National Instruments Reconfigurable Input/Output (RIO) hardware, simplifying the development cycle and the integration of advanced data acquisition applications in EPICS. RIO devices are implemented using XILINX FPGAs. These reconfigurable devices have to be programmed using the LabVIEW for FPGA tool that works directly with the XILINX compiler. EPICS (Experimental Physics and Industrial Control System) is a very well-known middleware used as distributed control system in scientific facilities running complex experiments. Among the most important facilities, EPICS is used at APS (Advanced Photon Source), ALS (Advanced Light Source), The International Thermonuclear Experiment Reactor (ITER), and the European Spallation Source (ESS). The main objective of this contribution is to provide a method to develop EPICS IOCs based on FPGA devices in which the user has defined a specific functionality. A traditional DAQ system is based on a specific hardware with vendor-defined functionalities. Therefore, the EPICS device support is implemented according to these fixed specifications. If another hardware model with different functionalities is selected, the user needs to modify the EPICS device support. On the contrary, IRIO provides an EPICS device support capable of connecting with any implementation in the FPGA if the user has followed a set of rules, named profiles. Using these rules the user can develop different implementations with multiple resources: DMA channels to move acquired data, registers for input/output operations, etc. The use of IRIO shorten the development cycle because the user only needs to design the specific application for the FPGA using LabVIEW for FPGA. With the help of templates the user develops its specific applications and compiles the design with the XILINX tools, this is transparent for the user because LabVIEW for FPGA interacts with XILINX tools. Once the user obtains the bitfile, it only needs to create the IOC and instantiate the PV templates provided according with the resources implemented in the FPGA. Therefore, the integration with EPICS is reduced only to a configuration process eliminating the necessity of developing code for device supports. IRIO tools also contain additional software packages to implement EPICS device support using ITER Nominal Device Support (NDS) approach or standalone applications directly using the RIO devices without the intervention of EPICS. IRIO software tools are currently integrated in ITER CODAC Core System as the main component to develop applications for the cRIO and FlexRIO devices in the ITER fast controller catalog. IRIO is distributed with a GPL V2 license to other research facilities using EPICS or other users interested in the development of advanced data acquisition applications.

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