



POLITÉCNICA



INSTRUMENTATION &  
APPLIED ACOUSTICS  
RESEARCH GROUP

## Analog Data Acquisition and Processing FPGA-based Solutions Integrated in Area Detector using FlexRIO technology

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### ABSTRACT

Analog data acquisition used in diagnostics and control of large physics experiments require high sampling rates and real-time functionalities. Field Programmable Gate Array (FPGA) devices allow efficient implementation of such solutions. Currently, large scientific facilities are using middleware platforms to simplify system integration. EPICS (Experimental Physics and Industrial Control System) is one of the most extended middleware for this purpose. Heterogeneous hardware integration in these systems is a complex task, and different approaches attempt to standardize. One of these approaches is areaDetector. An open source module for EPICS that is mainly used for image acquisition. areaDetector simplifies integration of heterogeneous image systems and provides a common interface for these systems, has also been used with some analog signals like quadEM. This paper presents the integration of an acquisition and processing solution in a PXle platform using FlexRIO technology via a hardware model that solves acquisition and processing in a FPGA and a software model implemented in C++ with the IRIO library (open source solution for RIO devices in the Linux environment) to get to EPICS through areaDetector with analog data.

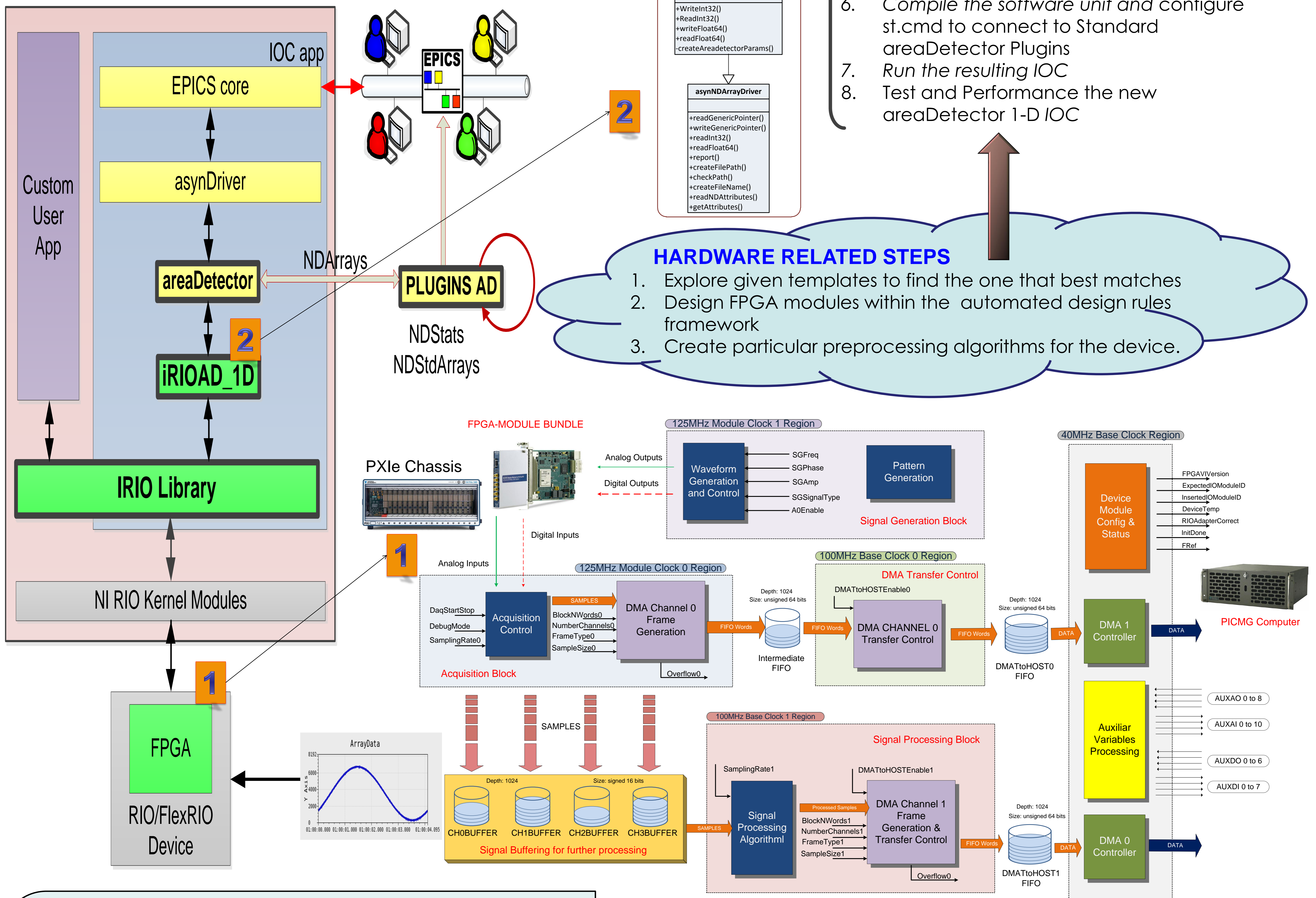
## Integrate FPGA IDAQs Systems in Distributed Control System EPICS with one C++ Class

### SOFTWARE RELATED STEPS

4. Create inherited class from AD\_1DDriver to access areaDetector Model and common PVs
5. Create methods and attributes that match the HW device created with HW steps
6. Compile the software unit and configure st.cmd to connect to Standard areaDetector Plugins
7. Run the resulting IOC
8. Test and Performance the new areaDetector 1-D IOC

### HARDWARE RELATED STEPS

1. Explore given templates to find the one that best matches
2. Design FPGA modules within the automated design rules framework
3. Create particular preprocessing algorithms for the device.



### CONCLUSIONS

- Analog Data Acquisition with high throughput inside areaDetector and EPICS, taking advantage of NDArrays strategy.
- New model to integrate 1-D acquisition devices inside EPICS with parallel and distributed processing
- Flexibility Through FPGA programming. Plenty number of templates available and high throughputs

- PXle form factor for Fast Controllers totally integrated with EPICS.
- Simplifies the design of high performance DAQ systems based on fully reconfigurable FlexRIO.

### FlexRIO HW for Fast Controller

Digital DAQ	Description	Features	Product	Description
PXle FPGA	NI PXle 796X Devices	Fully Reconfigurable LabVIEW Template	NI-5761R	14-bit 200MS/s Digitizer
Device Support	Complete Device Support Based on NDS	14-bit Acquisition@ 100MS/s	NI-5781R	14-bit 100MS/s Digitizer
CA EPICS Client	Example OPI Interface (GUI)	Complete Device Control	PXle 7961	FlexRIO device (FPGA module)
			PXle 7966	FlexRIO device (FPGA module)