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Introduction

A novel solution for integrating EPICS with CompactRIO, the real-time embedded industrial controllers by National Instruments (NI), is proposed under the name Nheengatu. The CompactRIO controller, which is equipped with a processor running a real-time version of Linux and a Xilinx Kintex FPGA, is extremely powerful for control systems since it can be used to program real-time complex data processing and fine control tasks on both the Linux-RT and the FPGA.



Aside from allowing EPICS to read/write variables from/to the FPGA, LabVIEW-RT or a wide diversity of peripherals, a strong focus of this project is to provide an infrastructure that is easy to integrate with synApps and supporting software, and to facilitate the deploy as much as possible.

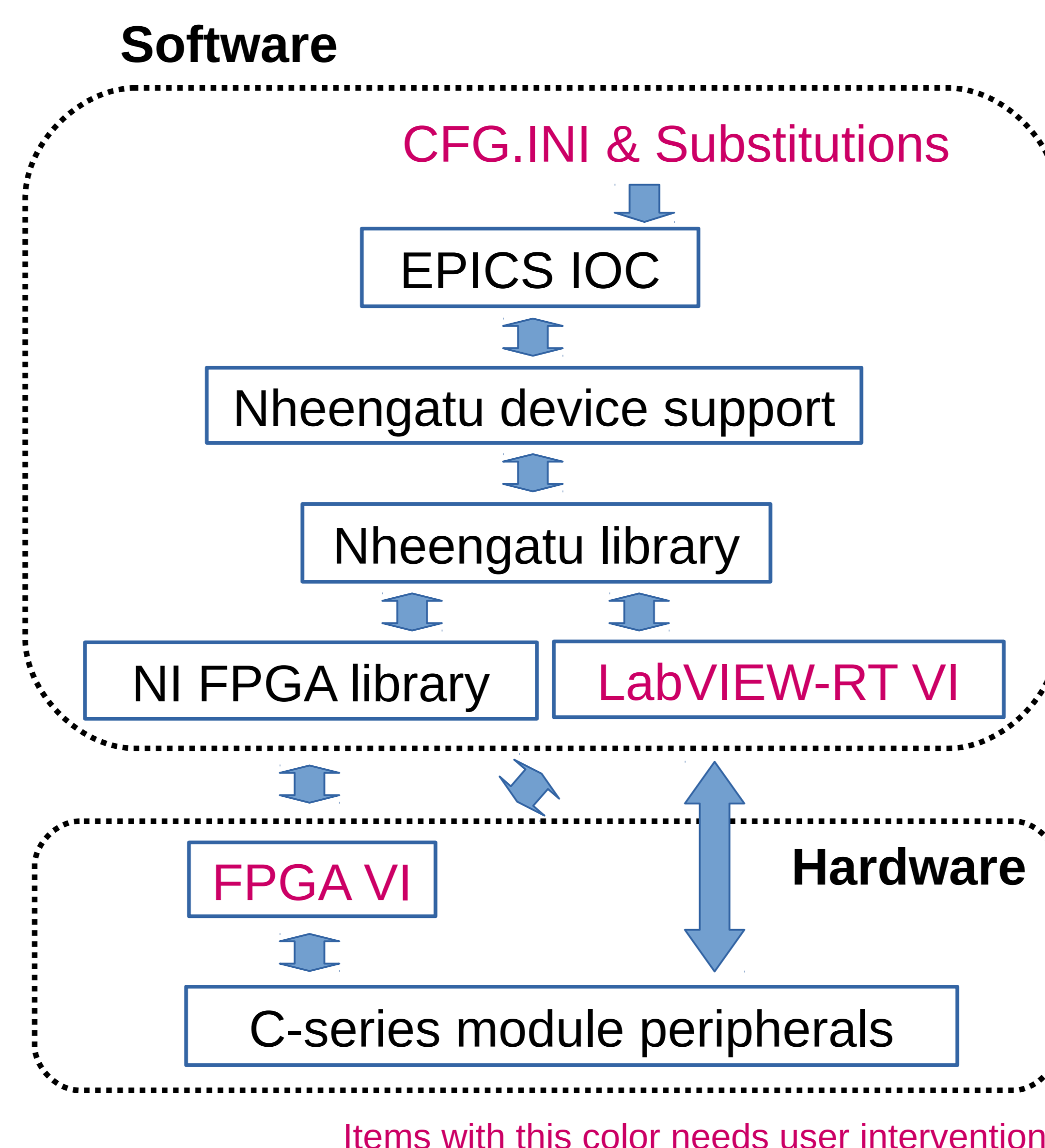
Nheengatu Architecture

C-series modules cover a great diversity of peripherals that are used for connecting to devices.

FPGA and LabVIEW-RT VI are applications that contain setup-specific implementations such as fine control state-machines, custom logic, or direct connections to peripherals.

NI FPGA Library is provided by national instruments to access controls and indicators.

Nheengatu library handles reading and writing to all LabVIEW-RT and FPGA VI variables.



Nheengatu device support supports (currently) binary input and output, analog input and output, scaler and waveform. It also exports the Nheengatu library configuration commands to the IOC.

EPICS IOC exports all variables indicated by the substitutions files and configures Nheengatu library and the FPGA at runtime.

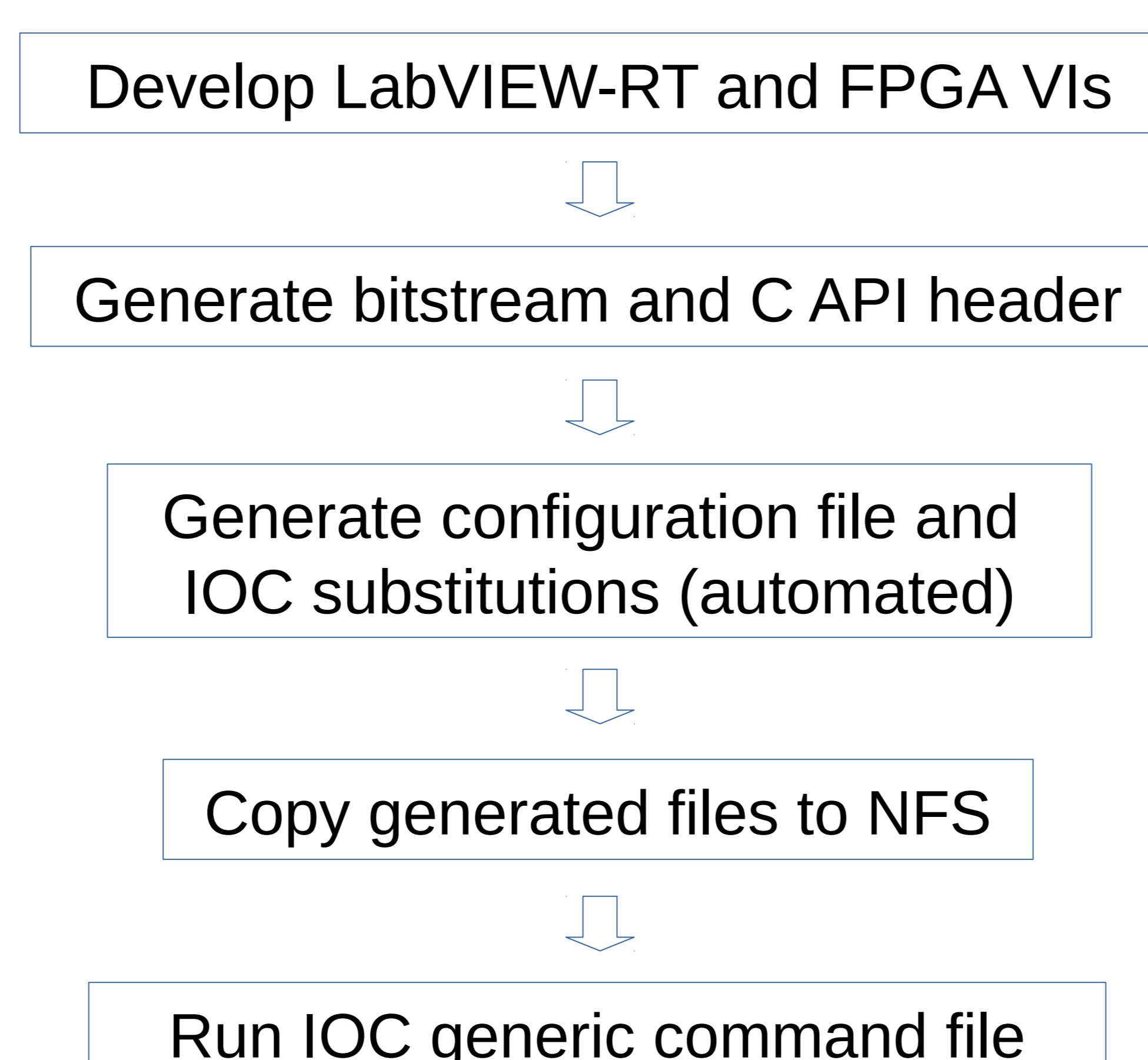
CFG.INI will be passed to the IOC at runtime. It contains all setup-specific details in which the Nheengatu library will use to send/receive data to/from the FPGA and LabVIEW-RT VIs.

Nheengatu deploy flow

Simplicity in integration and deploy is one of the main objectives of developing Nheengatu. The usage of setup-independent structures in the Nheengatu architecture together with automation scripts and Network File System (NFS) make an extremely powerful combination. EPICS IOC, Nheengatu device support, Nheengatu library and the NI FPGA library are located on the NFS and are used by all CompactRIO setups available. Consequently, the deploy process can be performed in a matter of minutes on a freshly formatted CompactRIO with no need to compile or modify a line of code.

Type	FPGA	LabVIEW-RT
Variable Read/Write	Single precision floating point, boolean fixed point, arrays (read)	Single & double precision floating point, I8, *16, I32, I64, U8, U16, U32, U64, boolean, arrays (read)
Scaler	64-counters digital / analog	

Supported types



Results & Conclusions

Nheengatu is currently being used in the X-Ray absorption and fluorescence spectroscopy (XAFS) and the imaging (IMX) beamlines. Nheengatu will also be present in the beamlines of SIRIUS, which is one of the first fourth-generation synchrotron lightsources in the world. The devised architecture is believed to be the simplest-to-use and the most flexible solution that exists up-to-date for integrating the CompactRIO controller with EPICS.