A versatile data acquisition system based on programmable hardware

Developing a silicon pixel detector? Need a DAQ for your prototype? Caribou can save your time!

Caribou hardware architecture

- FPGA/SoC board (e.g. Xilinx ZC706)
- An embedded CPU runs the operating system (Linux), DAQ and control software (Peary)
- An FPGA runs detector-specific hardware blocks for data processing and detector control
- Control and Readout (CaR) interface board
  - Provides physical interface from the FPGA/SoC to the detector chip
  - CaR – FPGA connection extendable by a cable (3 m tested)
- Application-specific detector carrier board
- Detector chip and passive components only

Caribou software architecture

- System: Yocto- and OpenEmbedded-based Linux ("Poky")
- DAQ library ("Peary") containing:
  - Hardware Abstraction Layer (HAL), allowing to handle hardware peripherals as objects in C++
  - C++ templates for implementing a new user device
  - Logging with multiple verbosity levels
  - Device manager supports multiple devices in parallel
  - Command line interface for standalone operation
  - Client interface for integration with another DAQ

Supported detectors

- ATLASPix2
- ATLASPix
- H3SDemo/FEI34
- ATLASPix

Testbeam integration

- Migrate the system to Zynq UltraSCALE+ (ZCU102 board)
- 64bit architecture, 4 cores, faster CPU
- DMA for fast data transfer
- New detectors support
- ATLASPix3, RD50, CLIPS

Supported detectors

- CLIC telescope in SPS North Area (CERN)
- EUDET telescope (DESY), fully controlled from EUDAQ2

Motivation

- A similar concept of readout, control and powering is used in most silicon pixel detectors
- Differs in voltage levels, number of channels or protocol
- A new detector-specific DAQ system is usually developed for each new detector
- Time-consuming process of HW/FW/SW development brings no innovative functionality
- A versatile DAQ system for prototyping can speed-up the development process
- Caribou, initially CarIBOu, started as a project for ATLAS by BNL, UniGE and CERN and is an acronym for Control and Readout Inner tracker Board
- Caribou provides HW and SW cores and Interfaces, only detector-specific part is modified