RTDP: Streaming Readout Real-Time Development and Testing Platform

Authors: Ayan Roy, David Lawrence, Jeng-Yuan Tsai, Marco Battaglieri, Markus Diefenthaler, Vardan Gyurjyan, Xinxin (Cissie) Mei

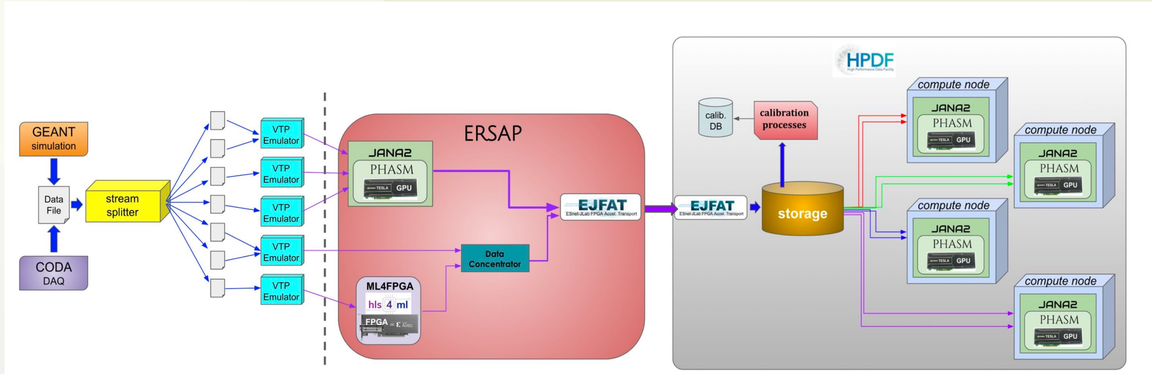
MOTIVATION

Experimental Nuclear Physics is moving towards a Streaming Readout (SRO) paradigm

Complex pipelines integrating heterogeneous hardware and varied software may have interference effects

Simulation and testing of complex SRO systems is needed to assist in their design and validation

Testing of complete, integrated SRO systems at scale for future experiments requires new tooling



Highly configurable multi-stream source allows realistic streaming simulations

Onsite components will implement first stages of data filtering/reduction

Offsite processing must incorporate built-in calibration latencies and storage. This will also help inform HPDF design

OBJECTIVE

- Deployment of a distributed (quasi) real-time SRO data processing model includes data calibration and full traditional off-line reconstruction.
- Framework optimization using GEANT-generated and archived beam-on data.
- Optimized framework validation with beam-on tests.
- Assessment of needed network and computing resources.
- Assessment of the performance for different hardware platforms.
- Identify potential issues relevant to a future HPDF in receiving and processing SRO data.

APPLICATION

- SRO Experiments requiring intricate configurations can be defined with user-friendly YAML
- Individual components such as calibration or data transport can be represented by software simulation modules
- Full simulation can include mixture of real and simulated components
- Scale from fully simulated on single PC to full use of hardware in distributed system

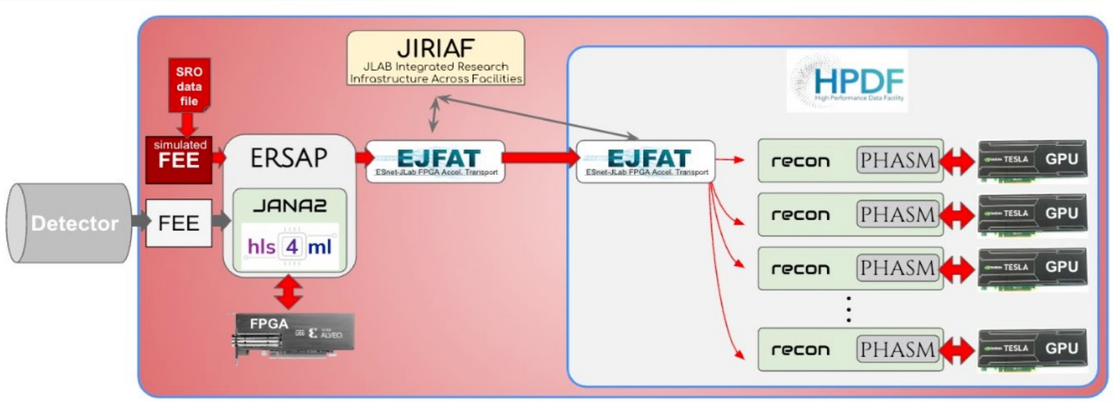


Diagram illustrating an example SRO system where data is streamed from the detector to

MEASURE OF SUCCESS

Specific milestones and objectives of the project include:

- Ability to launch synchronized processes across multiple nodes
- Integrated monitoring of all components in the system
- Ability to configure and simulate an experiment similar in size to the planned SoLID experiment at JLab
- Test with 400Gbps transfer speed, at least one FPGA and at least 1 GPU component

GOAL

- Create a platform to seamlessly process data from SRO to analysis on compute centers in various configurations
- Fully developed software platform that is capable of monitoring the components in a fully developed streaming system.
- Tools for fully simulating a real-time SRO data processing network from Front End Electronics to large compute.

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PROGRESS

RTDP is at the early stages of development. Here are some out of many things we have worked on:

- Captured CLAS12 data, streamed across the Jlab campus using a 100Gbps high-speed NIC featuring hardware timestamps.
- Captured data using synchronized streams from multiple network sources.

FUTURE WORKS

- Create stream splitter program for EVIO or HIPO data formatted files
- Create stream splitter program for simulated data in PODIO for ePIC
- Create VTP emulator using files produced by stream splitter
- Integrate Hydra as monitoring component.

Jefferson Lab

EPSCI Experimental Physics Software and Computing Infrastructure

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