Plans of the streaming readout consortium

Jan C. Bernauer
for the eRD23 EIC Streaming Readout Consortium

February 26, 2019

RBRC
RIKEN BNL Research Center

Stony Brook
University

Who are we: SRC members

- Catholic University of America: S. Ali, V. Berdnikov, T. Horn, M. Muhoza, I. Pegg, R. Trotta
- INFN Genova: **M. Battaglieri,** A. Celentano
- Stony Brook University / RBRC: **J. C. Bernauer**
- Massachusetts Institute of Technology: D. K. Hasell, R. Milner
- Thomas Jefferson National Accelerator Facility: C. Cuevas, M. Diefenthaler, R. Ent, G. Heyes, B. Raydo, R. Yoshida

Additionally many regulars like Martin Purschke (BNL), Marco Locatelli (CAEN), Jin Huang (BNL), Esko Mikkola (Alphacore), ...

$\longrightarrow$We welcome new members!$\longleftarrow$

Glossary

- Streaming readout: No electrical signal ("trigger") required to start acquisition.
- Enables, but does not require to save /all/ data
- Working point: Streaming readout with filter equivalent to triggered readout
  - But simpler: No/far less strict time constrain on filter decision
  - Filter decision can make use of more information, more precise, "trigger" on signatures not possible in classical triggers.
  - Data reduction can be more effective.
  - If enough bandwith: can save more data, can define "trigger" after exp.

Funding

All funding for work comes from mainly non-EIC sources.
Because of the funding situation, all subgroups follow their own subproject. Few "global" EIC projects. Main overaching activity (so far) are

- Monthly phone meetings
- Regular workshops

Next workshop

- **Camogli, Genova - Italy, May 22-25**
- EIC progress, but also reports from other projects
- Hope for many contributions from EU labs like GSI, CERN
- Progress on ongoing projects
  - Hardware
  - Working prototype streaming readout
  - Validation of streaming vs. triggered readout

Have funds to support travel, will aim to help students

Future plans

- Compare approaches of the different existing streaming readout systems for technical questions
  - Timing distribution
  - Network architecture
  - ...
- Prototype on-wire protocol specification
  - Request For Comments style
- Try to answer how benefits seen by other projects translate to EIC
  - Reach out to EICUG

Protocol design

- Will meet with Markus Diefenthaler early April
- Goal is to design a general on-wire protocol
  - "Zero-copy" merge/drop of data
  - straight forward implementable in FPGA and software
  - language agnostic
- Will base prototype software on this.

Hardware development

- BNL: sPHENIX oriented hardware design, possible base for EIC
- JLAB: INDRA laboratory
- MIT and others: Interest to work with Alphacore

sPHENIX DAQ workfest

- sPHENIX has hybrid system. *CALs are triggered, TPC is streaming
- Decided to not do full online event building.
  - simpler
  - less risk: Offline event building can be redone
- Personal observation: We discussed about triggered part a lot longer than about streaming part. This indicates to me that trigger has more critical points.

Some thoughts

- Many, but not all modern FEE are streaming. Typically converted to "triggered" via temporal ring-buffer indexed by trigger.
- Trivial to convert to full streaming.
- Downside of streaming: Can not use multiplexers like APV, DREAM etc.
  - However: Multiplexing means deadtime.
- Only streaming can achieve close to 100% livetime

Some more thoughts

- TPC at 100 kHz need streaming readout or will have too much deadtime
- Network bandwith is cheap now. Will be cheaper in the future.
- Long term storage is bottleneck. But will get cheaper.
- Independent of bandwith: Streaming DAQ can make better use of it.

Even more thoughts

- Moves critical points from online to offline: Can "redo" event building, trigger.
- Moves work from hardware/firmware to software: Opens up pool of people capable of contributing.