Online Software for CBM

Dominik Smith

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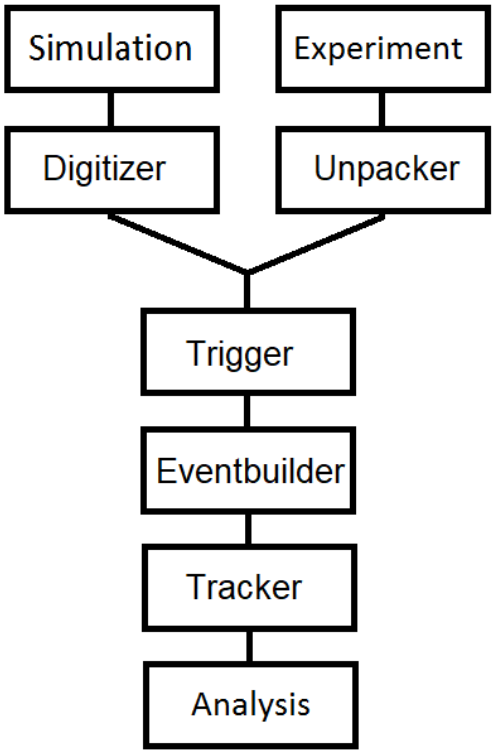


Challenge:

- Heavy-ion collisions at unprecedented interaction rates at CBM.
- Requires novel read-out and data acquisition concept with self-triggered front-end electronics and free-streaming data.

Goal: Make readout chain „online ready“.

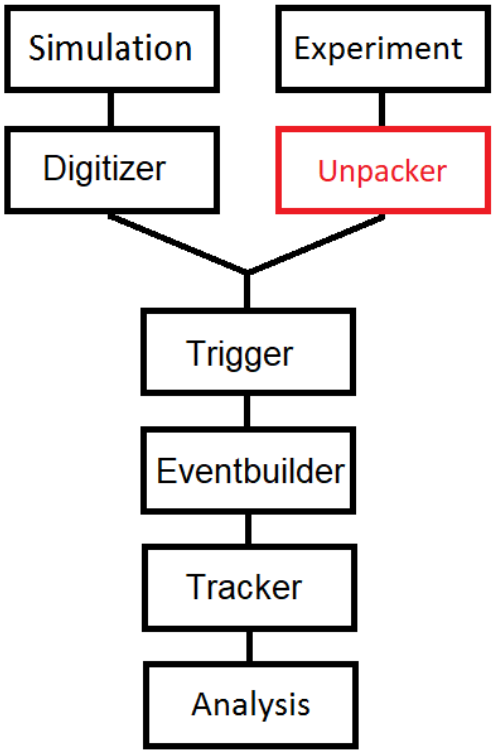
- Implement „algo“ classes in cbm::algo namespace.
- Smallest (algorithmically) possible detector unit (parallelizable).
- ROOT-free. Separate monitoring. Optimize for speed.

Steps:

- Survey and cleanup of existing classes.
- Porting to cbm::algo.

This talk: Overview of completed and ongoing work.

Unpackers



Principle:

- Multiple CRIs (or DPBs) connected to FLES.
- Multiple FEBs connected to one CRI.
- Multiple ASICs on one FEB.
- Multiple sensor channels send signals to one ASIC.

First Level Event Selector
Data Processing Board
Common Readout Interface
Front End Board

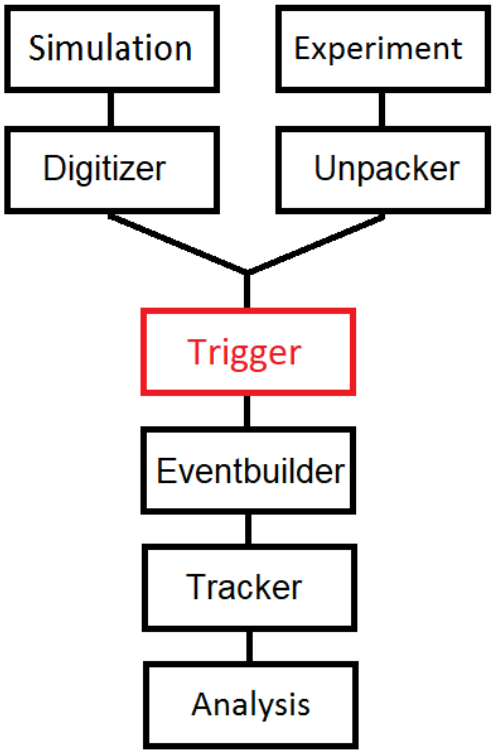
Unpacking: **Translate messages to universal format**

- Local addresses are specific to current level in the hierarchy.
- Local times are cyclical w.r.t. special messages.
  → go from local to global time and addresses.
- Also: apply calibration for charge
- In cbm::algo: One unpacker per timeslice component (CRI)

Completed: **Unpackers for STS, MUCH, TOF, T0**

Ongoing: **Unpacker for TRD**

Trigger algorithm

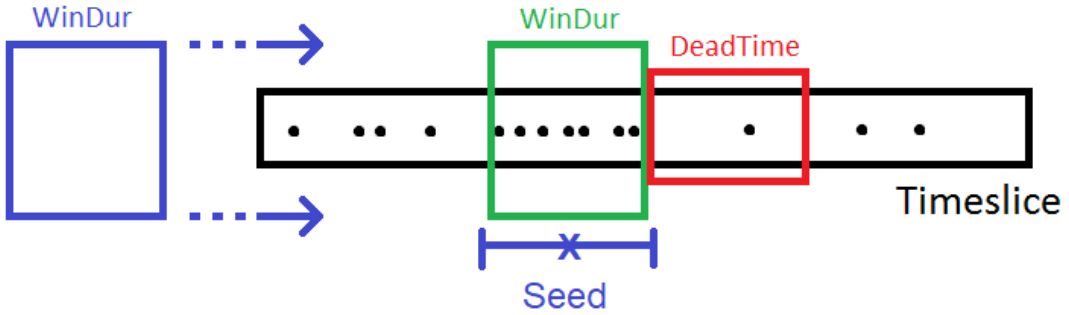


Triggering: **(„digis“ = unpacked messages)**

- Identify „points of interest“ in digi stream, i.e. „event candidates“.
- Precursor to eventbuilding.

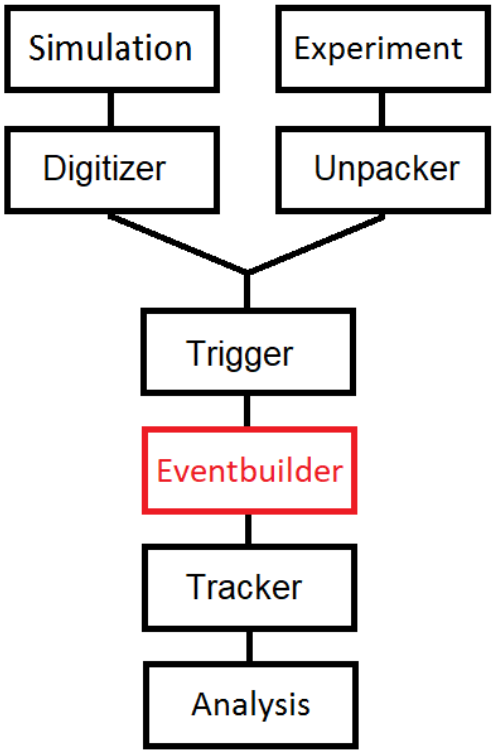
Principle:

- Shift „sliding window“ through digi stream (single or multiple trigger detectors). Trigger when digi count exceeds defined threshold.



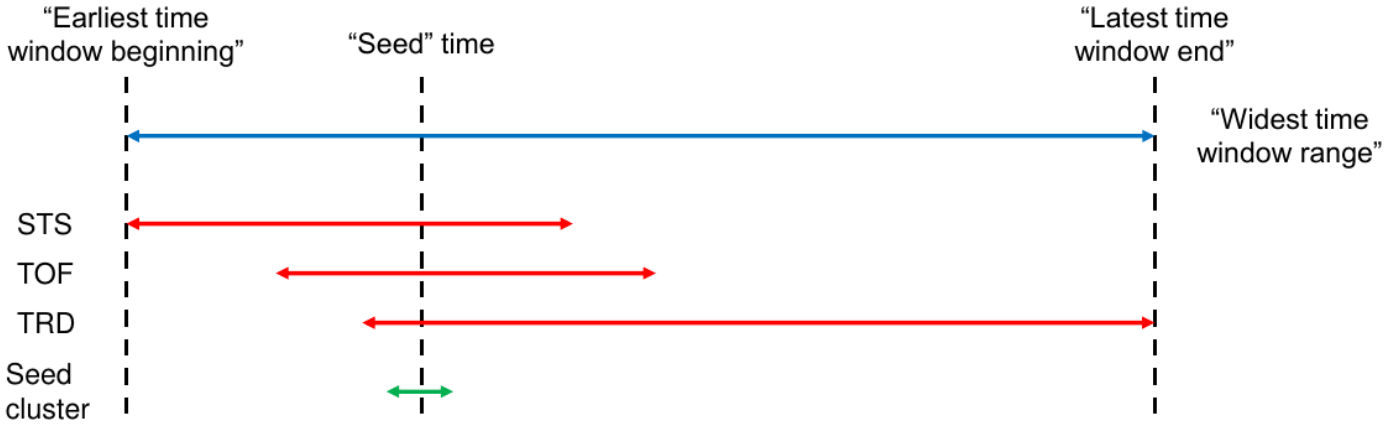
Completed: **„Time cluster trigger“ algorithm in cbm::algo.**

Eventbuilder + Event selector



„Time window“ eventbuilder:

- Collect digis from pre-set time intervals around trigger.
- Window boundaries chosen separately for detectors.

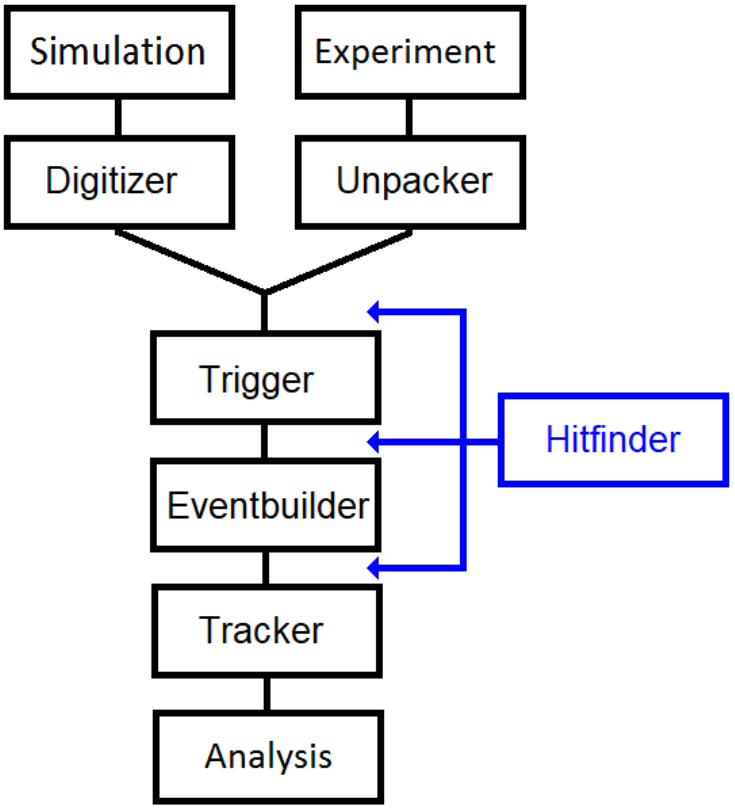


Event selector:

- Accept / reject events based on cuts
- Currently: minimum number of fired TOF stations / STS layers

Both completed and ready for use!

TOF Hitfinder



Hit finding:

- Sometimes single particle hit makes multiple digis.
- Reconstruct physical hits from digis.
- Intermediate step.

New classes for TOF:

- „HitFinderTof“ in cbm::algo
- ROOT-free except ROOT::Math classes (Rotation3D, XYZVector, not TObject).
- One object per RPC.
- Based on CbmTofSimpleClusterizer

RPC: resistive plate chamber;

TOF Hitfinder

Principle:

- CbmTofHit objects from clusters of digis within one (for each) RPC.
- For each timeslice:

1) *Calibrate digis (apply offset to time, gain and walk correction to charge)*
2) *Sort digis by SM, RPC and channel.*
3) *Loop over channels for each RPC.*
4) *Build digi clusters:*
   - *Require digi on each „side“ of channel*
   - *Add others in spatial and temporal proximity*
5) *Build hits from clusters:*
   - *Hit X and T from charge-weighted digi distro*
   - *Time error from detector resolution*
   - *Channel address of weighted position*

New class ready for use!

RPC: resistive plate chamber; SM: super module;

FAIR MQ Devices

FAIR MQ: Message Queuing Library and Framework

- System for large-scale („online“) data processing workflows.
- From FAIR MQ doc:

  - asynchronous message passing abstraction (of different data transport technologies)
  - efficient data transport service (zero-copy, high throughput)
  - data format agnostic
  - basic building blocks for higher level data processing workflows.

In practice:

- FAIR MQ „devices“ send / receive serialized messages through TCP channels.
- Optionally: Monitoring data sent to HTTP server.

Completed: **MQ devices for unpackers, trigger, eventbuilder**

Conclusions / Outlook

- Not covered here: **Tracking (V. Akishina, S. Gorbunov, S. Zharko)**

- Implementation of online software well underway.
- See also: Summary talks by I. Selyuzhenkov and J. Eschke.

Thanks for listening!

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