Some thoughts on online computing in CBM

V. Friese
CBM Online Meeting, 2 September 2022

Work Flow: Time-based online reconstruction

Processing step	Data flow
Unpacking	fles::timeslice -> DigiTimeslice
Timeslice reconstruction	DigiTimeslice -> RecoEvent list
Event filtering	RecoEvent -> decision
Event building	DigiTimeslice, trigger time -> DigiEvent
Event storage	DigiEvent -> file

Work Flow: Event-based online reconstruction

Processing step	Data flow
Unpacking	fles::timeslice -> DigiTimeslice
Trigger	DigiTimeslice -> trigger time list
Event building	DigiTimeslice, trigger time -> DigiEvent
Event reconstruction	DigiEvent-> RecoEvent
Event filtering	RecoEvent -> decision
Event storage	DigiEvent -> file

Work Flow: Event-based online reconstruction (mCBM)

Processing step	Data flow
Unpacking	fles::timeslice -> DigiTimeslice
Trigger	DigiTimeslice -> trigger time list
Event building	DigiTimeslice, trigger time -> DigiEvent
Event filtering	DigiEvent -> decision
Event storage	DigiEvent -> file

n.b.: a decision based on the DigiEvent may be possible for mCBM, but seems not feasible for full CBM.

Work Flow: Offline

Processing step	Data flow
Event reconstruction	DigiEvent-> RecoEvent
Analysis	RecoEvent list -> results

Commonalities

Online time-based	Online event-based	Offline
Unpacking		
	Digi Trigger	
Timeslice Reconstruction		
Event Building		
	Event Reconstruction	
Event Filter		
Event Storage		

Commonalities

Online time-based	Online event-based	Offline
Unpacking		
	Digi Trigger	
Timeslice Reconstruction		
Event Building		
	Event Reconstruction	
Event Filter		
Event Storage		

colour code: status in algo namespace

Data interfaces

- Fles::Timeslice
- DigiTimeslice
- DigiEvent
- RecoEvent

RecoEvent should be a container of all reco data (hits, tracks, primary vertex) within one event. Similar to DigiEvent.

Current model: Data branches in ROOT tree -> Not well suitable as general interface?

Remarks 1: What Do We Store

- Current work hypothesis: we store digi events.

- That means discarding any reco information obtained online.

- Events have to be reconstructed again offline (on-the-fly or by producing AODs).

- Cannot we store reco events (hits, tracks)?

- Arguments:

  – Digis are as close to the raw data as we can get.

  – Any information discarded during reconstruction would be irrecoverable.

  – We would give up the option to reconstruct offline with different settings / options / algos / alignment.

  – We might need only partial reconstruction online (for the filter decision).

- For a final decision, file sizes need be compared. If there is a large difference, we will have to review the issue.

  – This requires re-working the reco data classes.

Remarks 2: Time-based vs. event-based

- The definition of events based on the digi time distribution has limitations for higher event rates (> 1e6 / s).

- However, defining events as early as possibly has some attractive features:
  - Reduction of data volume for reconstruction (inter-event noise): relevant for lower rates; at high rates data volume may even increase (event overlap, duplication of digi data in different events).
  - Reconstruction and filtering of events can be easily parallelised (data-level), without the need to parallelize the algorithms.

- How far should we push the event-based option?

Remarks 3: Reconstruction time-based vs. event-based

- The algos for hit and track finding can be the same if they are 4-D.
  - Difference only in size of input data.
  - 4-D may be overkill for event-based, but the overhead is probably negligible.
  - The advantage to develop and maintain a single algo for both is dominating.

- A difference between time-based and event-based comes at primary vertex finding:
  - Event-based has to find a single PV from the track data.
  - Time-based has to find a series of PV in space and time and do event definition based on that.
  - Still, the algorithm can be the same (in event-based, it should deliver just one vertex).

Remarks 4: Reconstruction online and offline

- Online: reconstruct only detectors relevant for event filter (physics)

- Offline: reconstruct all detectors

- Reconstruction must be strongly configurable!