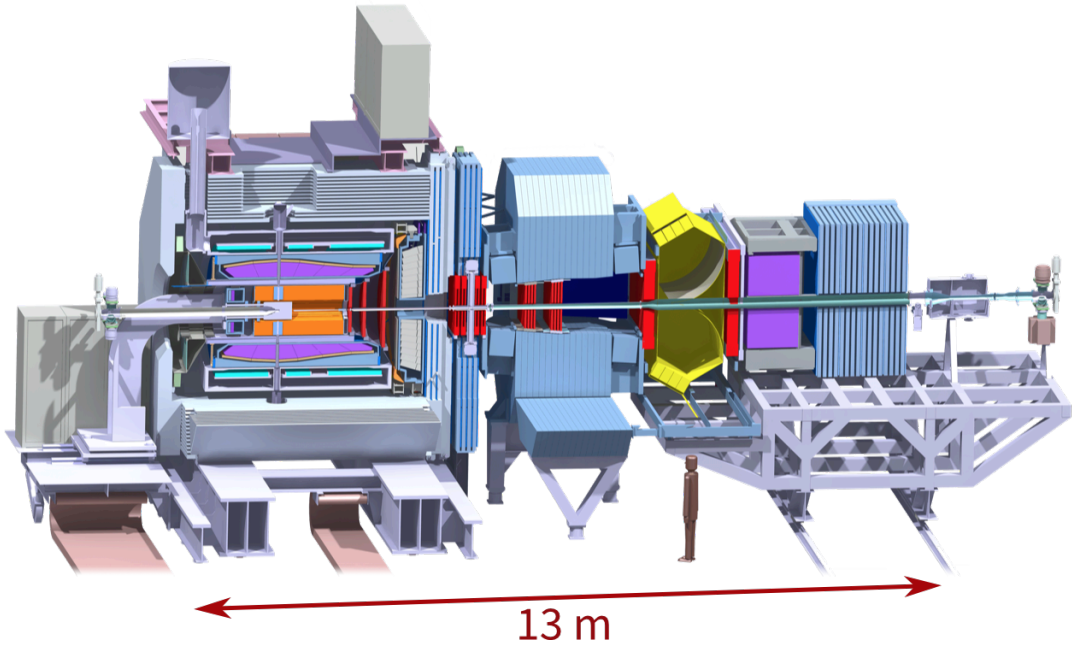
FairMQ for Online Reconstruction

An example on PANDA test beam data

Oktober 11, 2016 | Tobias Stockmanns on behalf of the PANDA collaboration

PANDA



Incoming data rate: 200 GByte/s

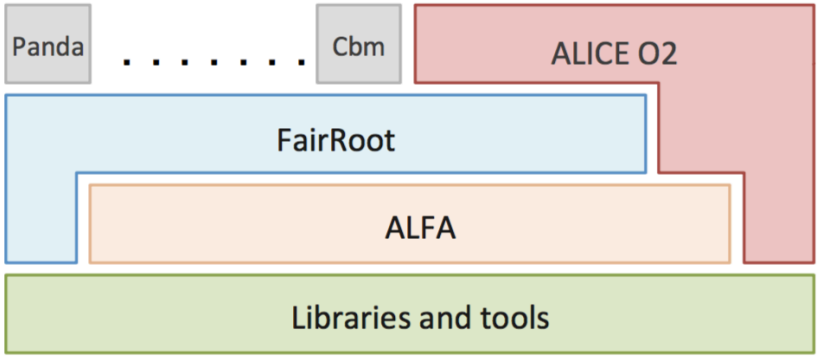
Reduction factor: 1000

Offline storage (incl. sim.):
3 PByte/year

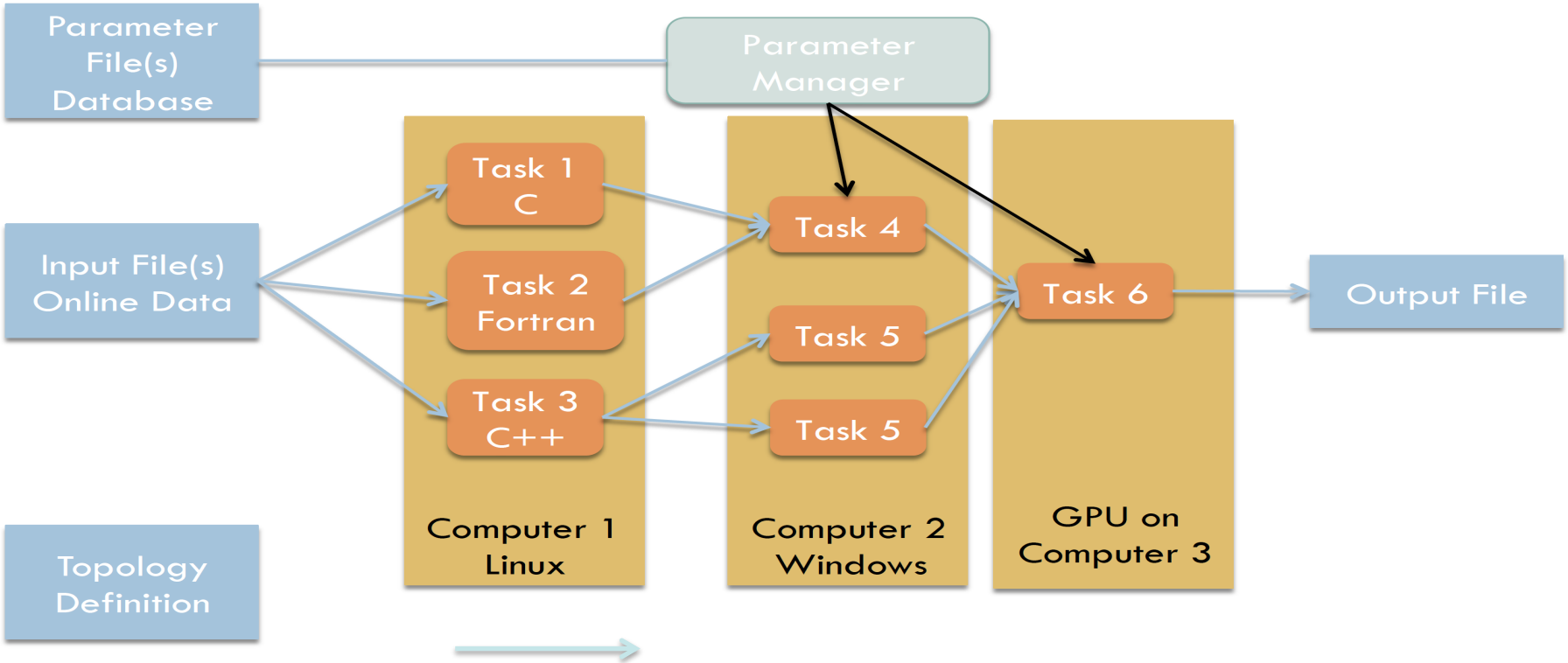
ALFA

- Developed in common by FairRoot Group, experiments at FAIR and ALICE
- Has data-flow based model (Message Queues based multi-processing)
- Provides configuration, process management and monitoring tools
- Provides unified access to configuration parameters and databases

➔ FairMQ

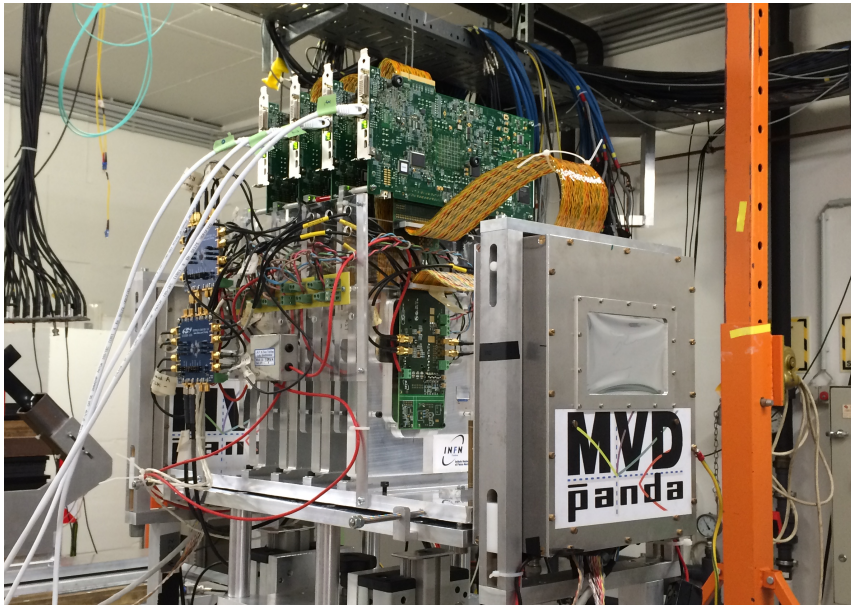


FairMQ



FairMQ: Message Queue

Test of FairMQ with Real Data



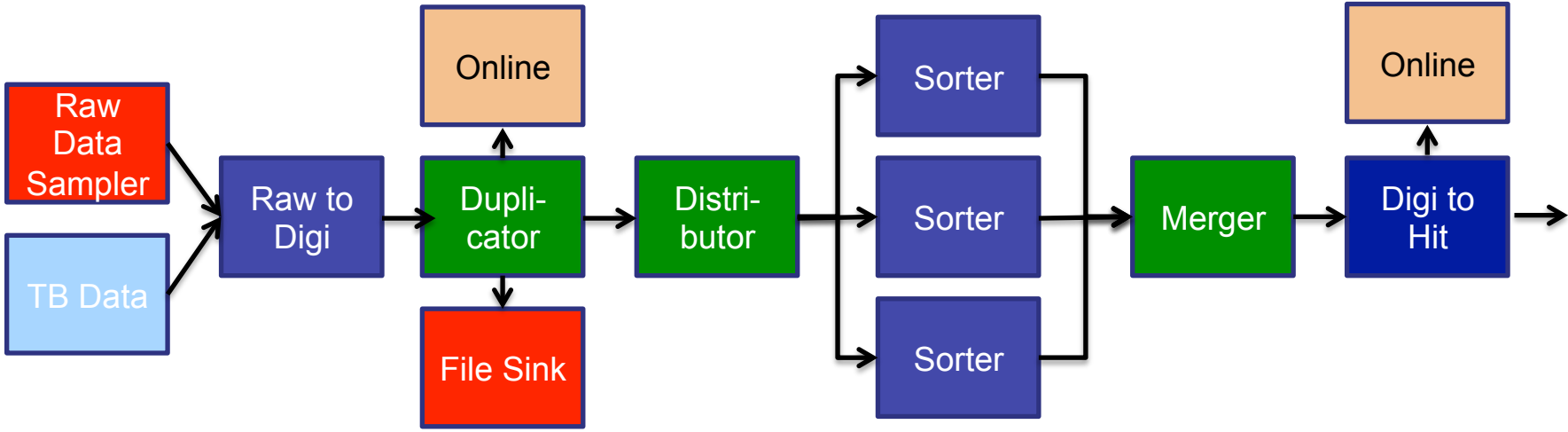
- Parallel readout of 4 pixel detectors
- Readout done by 4 FPGA boards sending their data to two PCs
- On the PC bitstream converted into raw data
- Raw data send via FairMQ to a FileSink

Idea

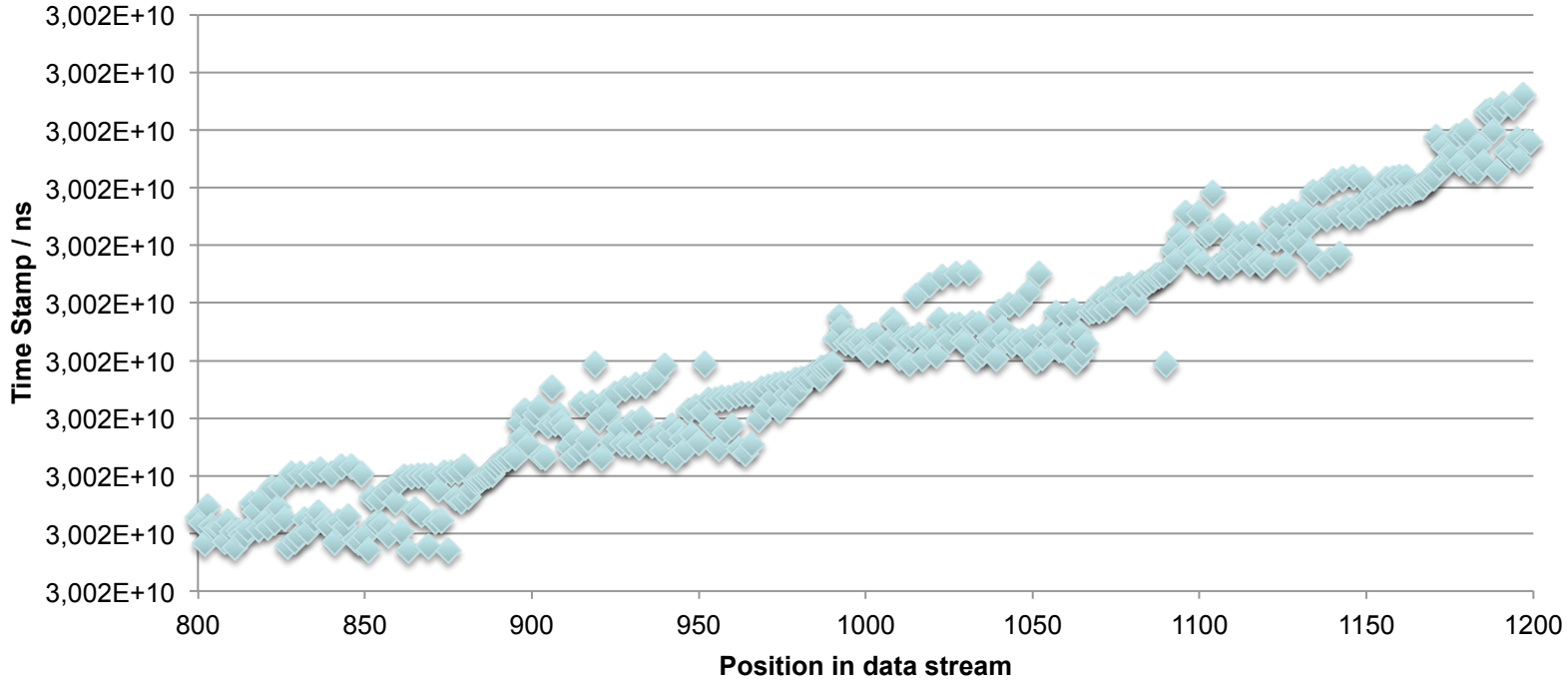
- Use MQ to completely process TB data online
- Processing steps:
  - Convert raw data into Digis
  - Sort by time stamp
  - Build “event”
  - Find cluster
  - Convert Digis into Hits
  - Combine data stream of all four ASICs
  - Build global event
  - Find Tracks
  - Fit Tracks

4 x Single FE

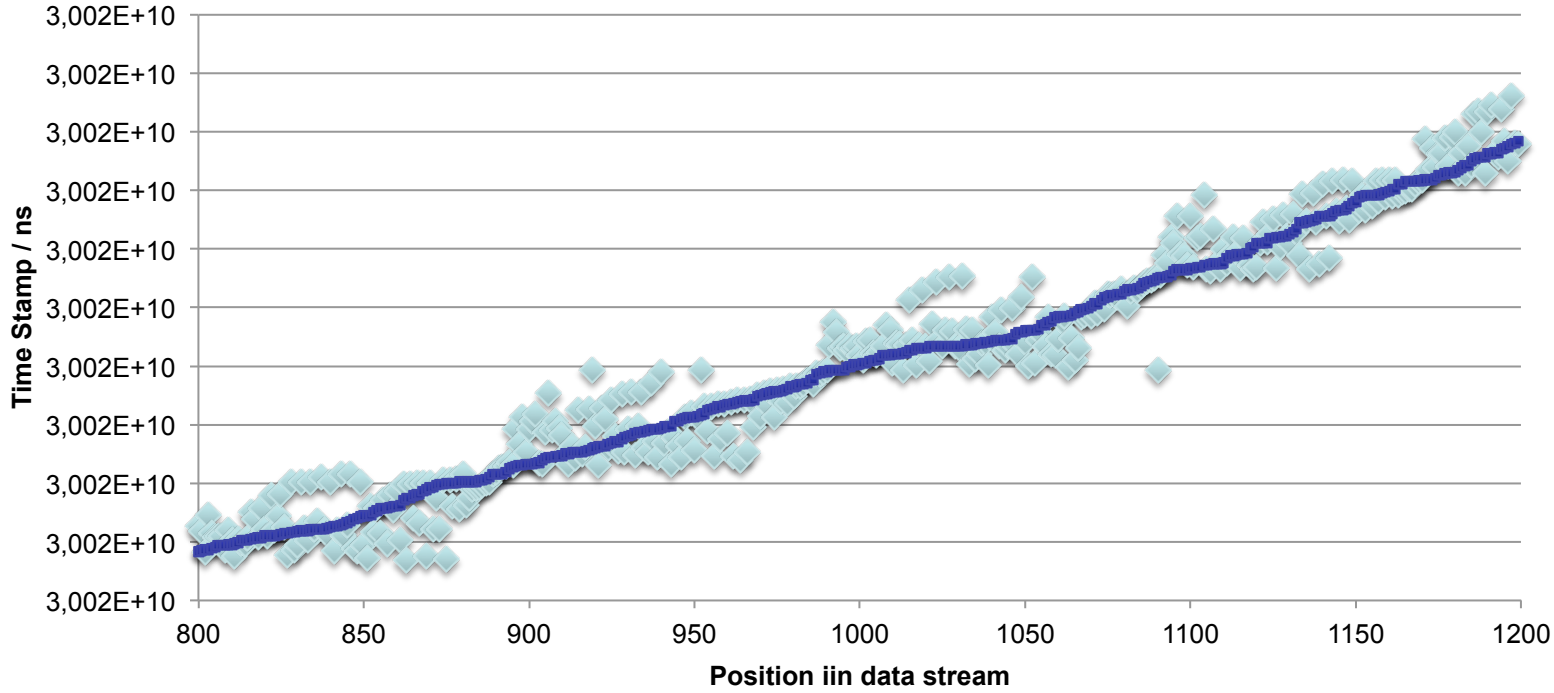
Single Front-End



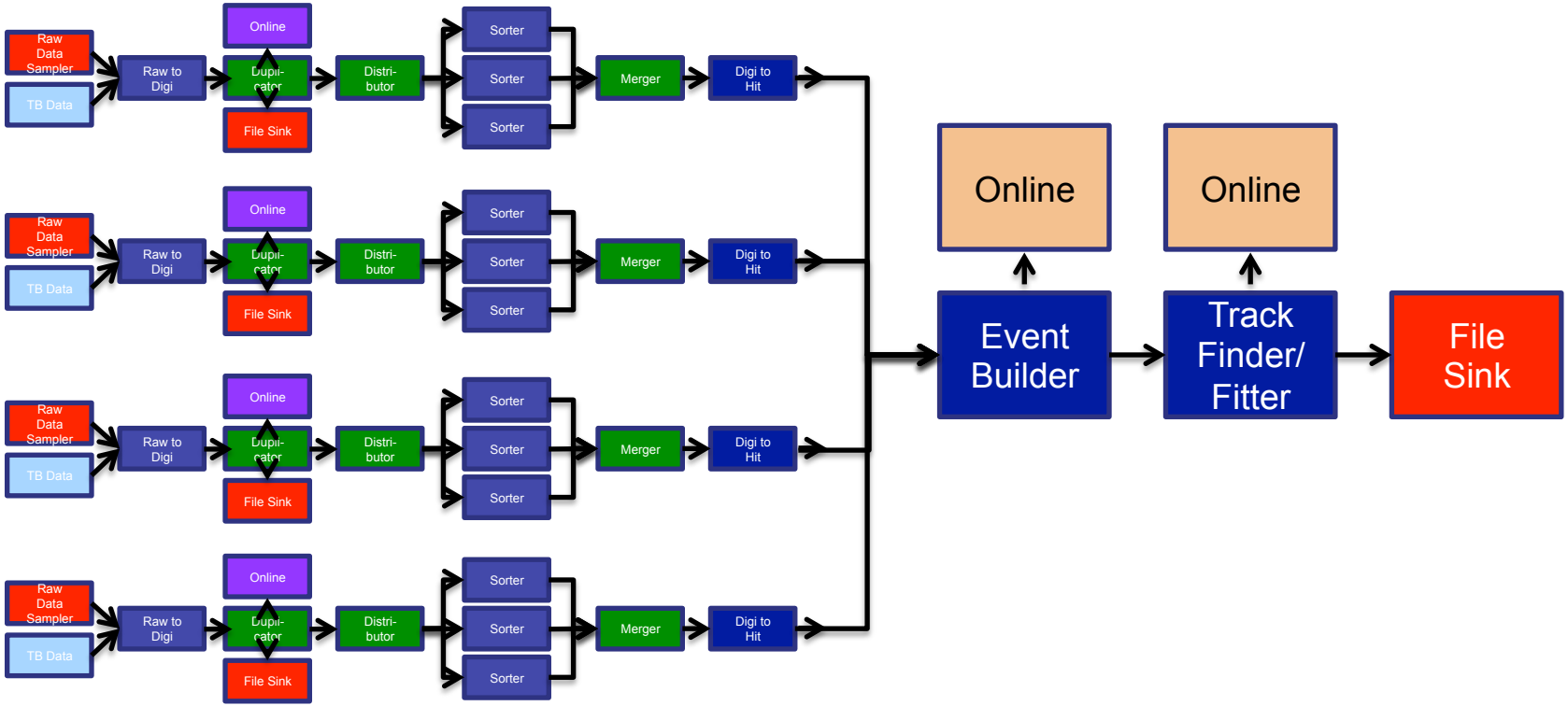
Distributor



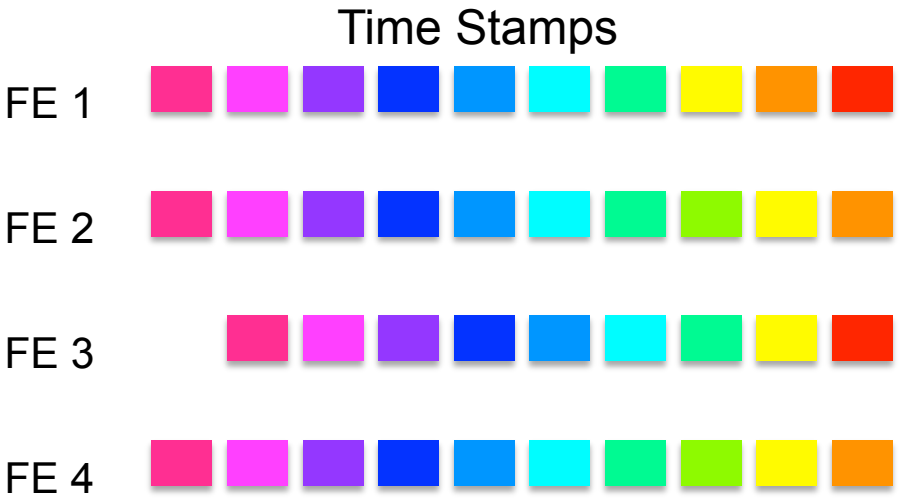
Data after sorting



Multiple Front-Ends

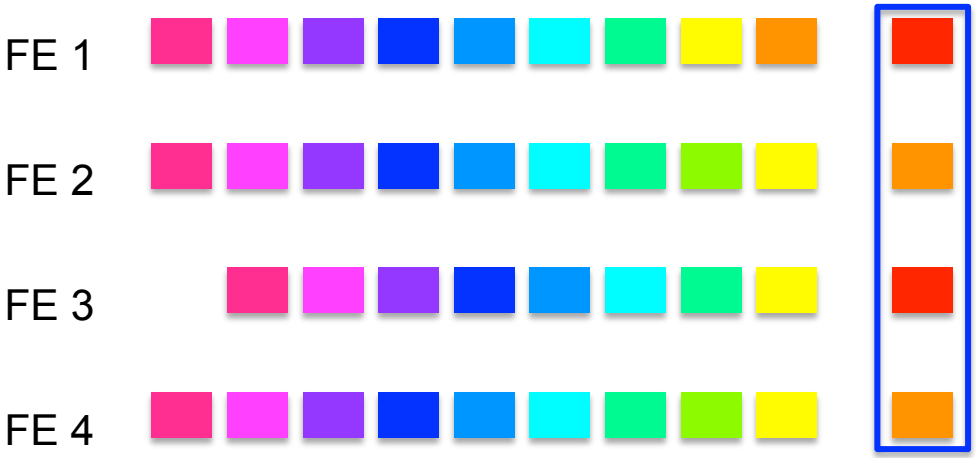


Event Builder



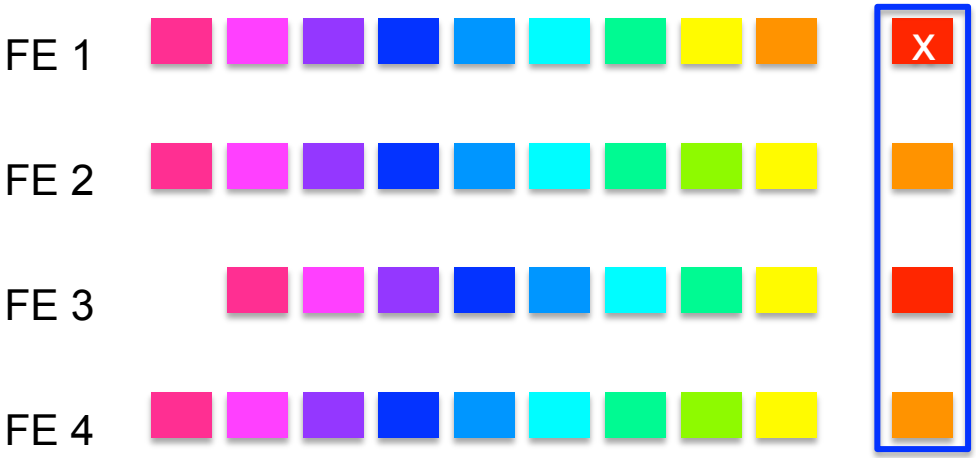
- Data of each FE sorted in time

Event Builder



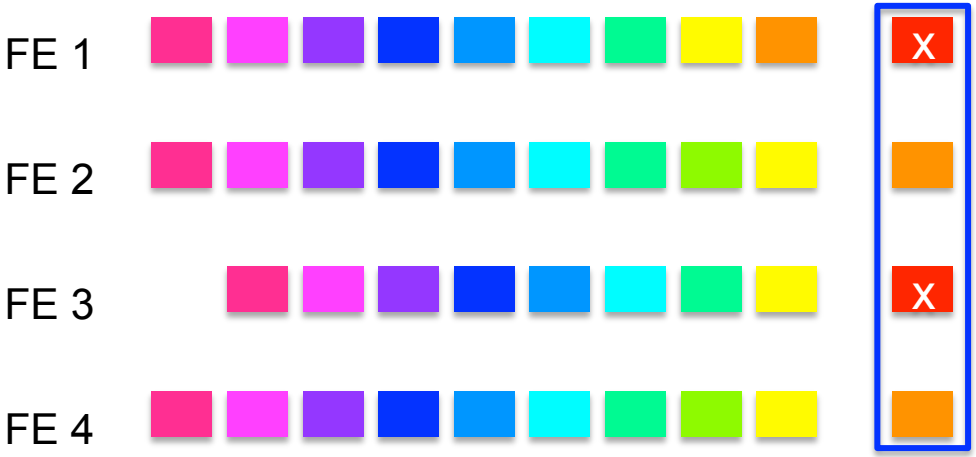
- Take first in stack

Event Builder



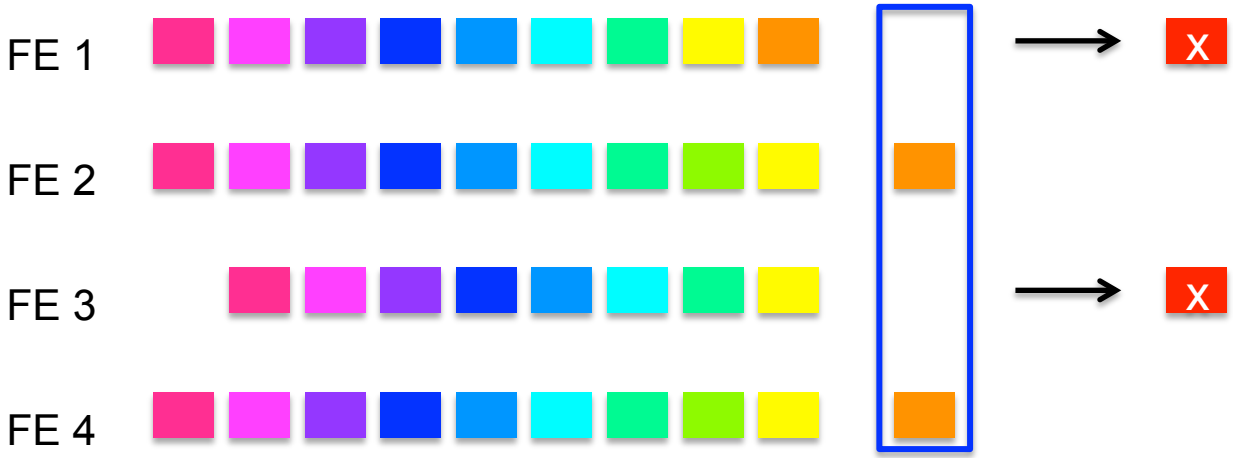
- Take first in stack
- Take earliest

Event Builder



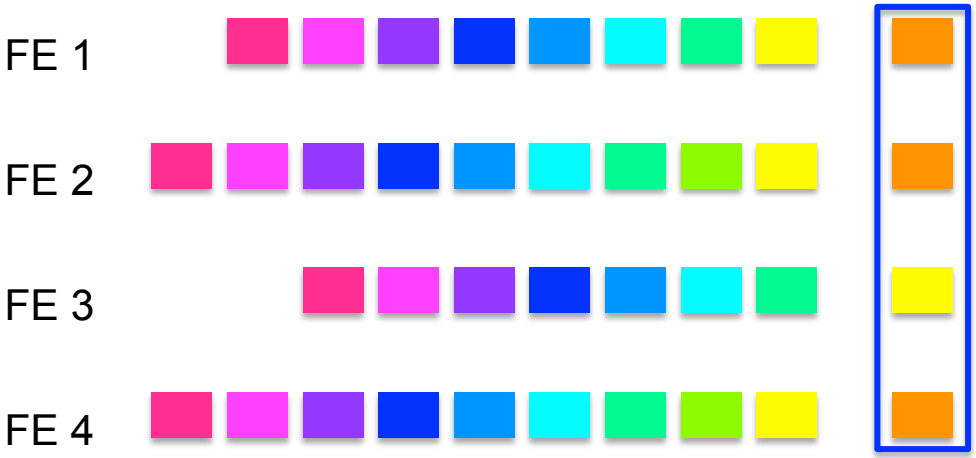
- Take first in stack
- Take earliest
- Search for matching hits

Event Builder



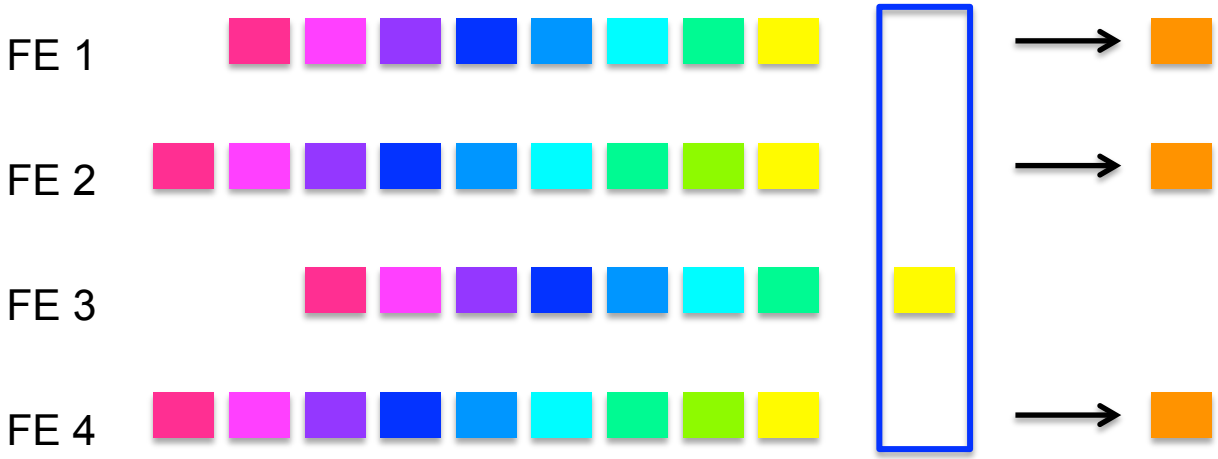
- Take first in stack
- Take earliest
- Search for matching hits
- Write out those in one event

Event Builder



- Fill empty positions with next hits

Event Builder

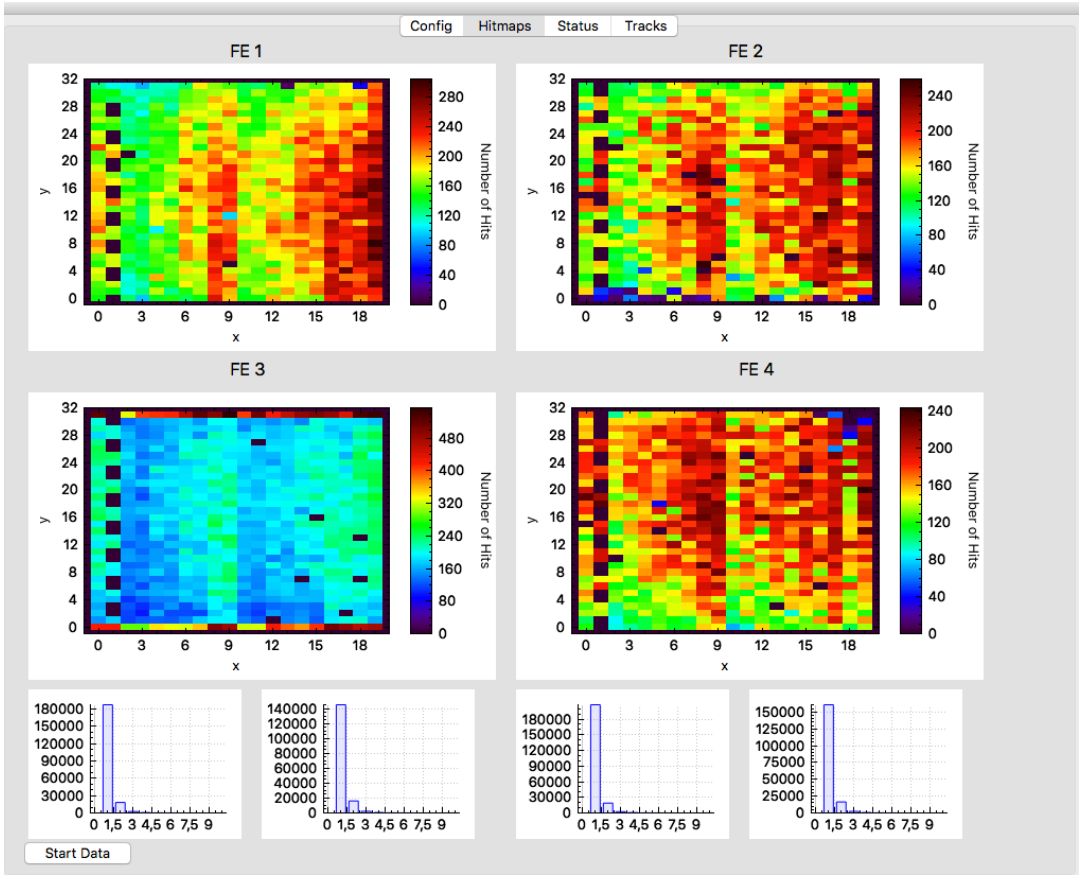


- Fill empty positions with next hits
- Repeat selection

Event Builder

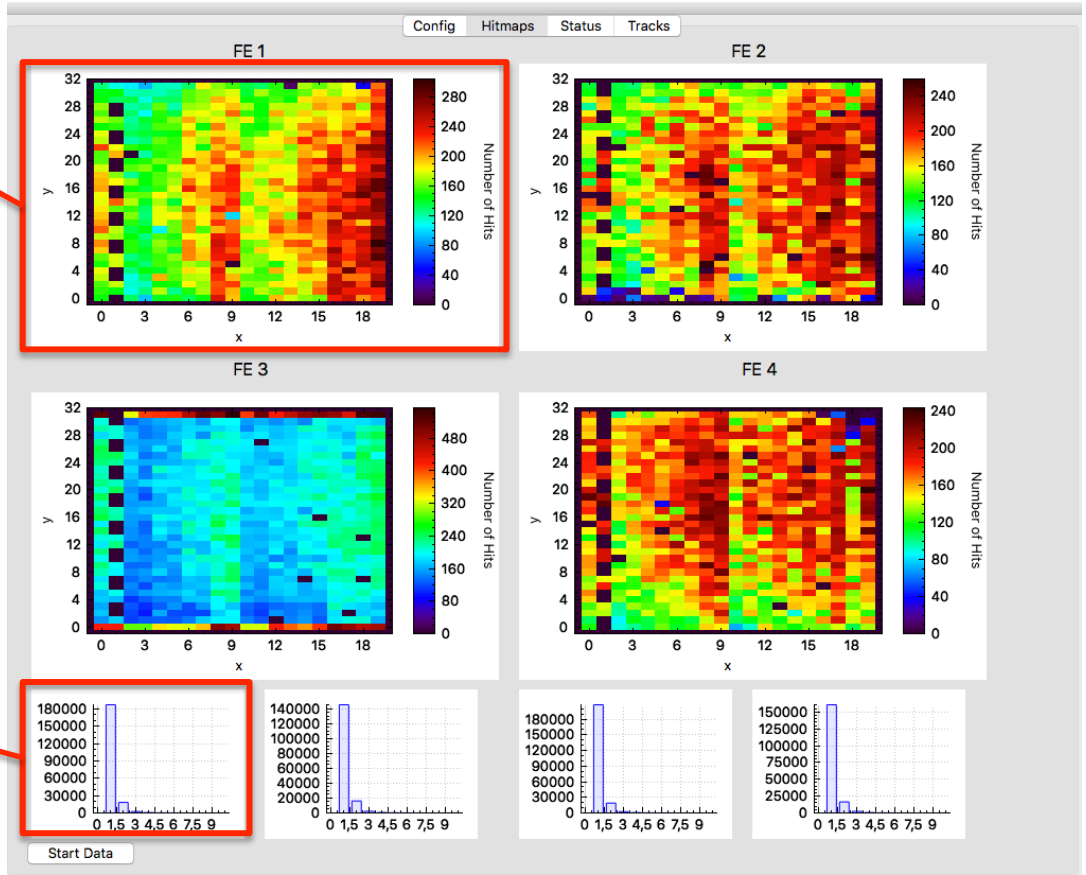
- Fill empty positions with next hits
- Repeat selection

Online Monitoring



- running on 6 PC
  - 4 for each FE
  - 1 for tracking
  - 1 for control

Online Monitoring

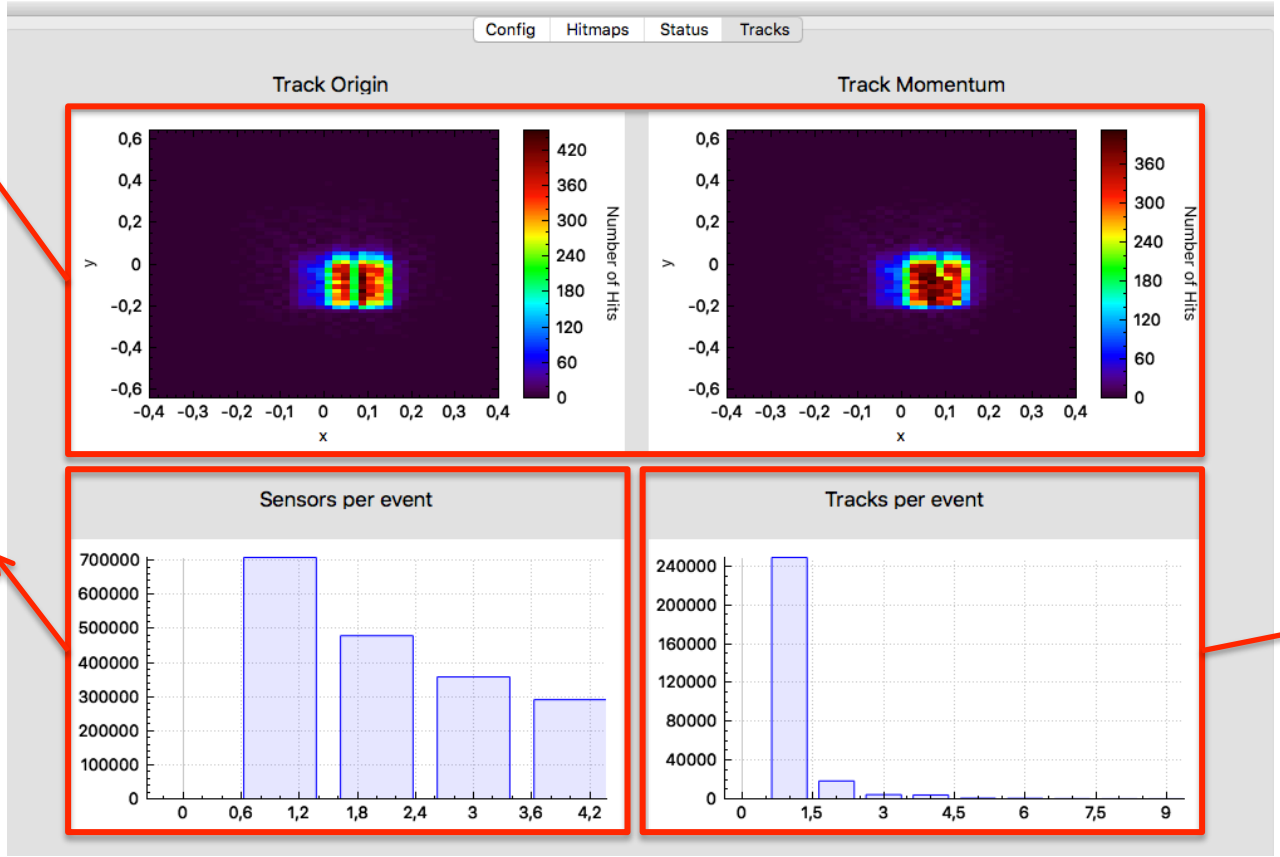


Hitmap

Cluster finder

- Running on 6 PC
  - 4 for each FE
  - 1 for tracking
  - 1 for control

Online Monitoring



Track fitter

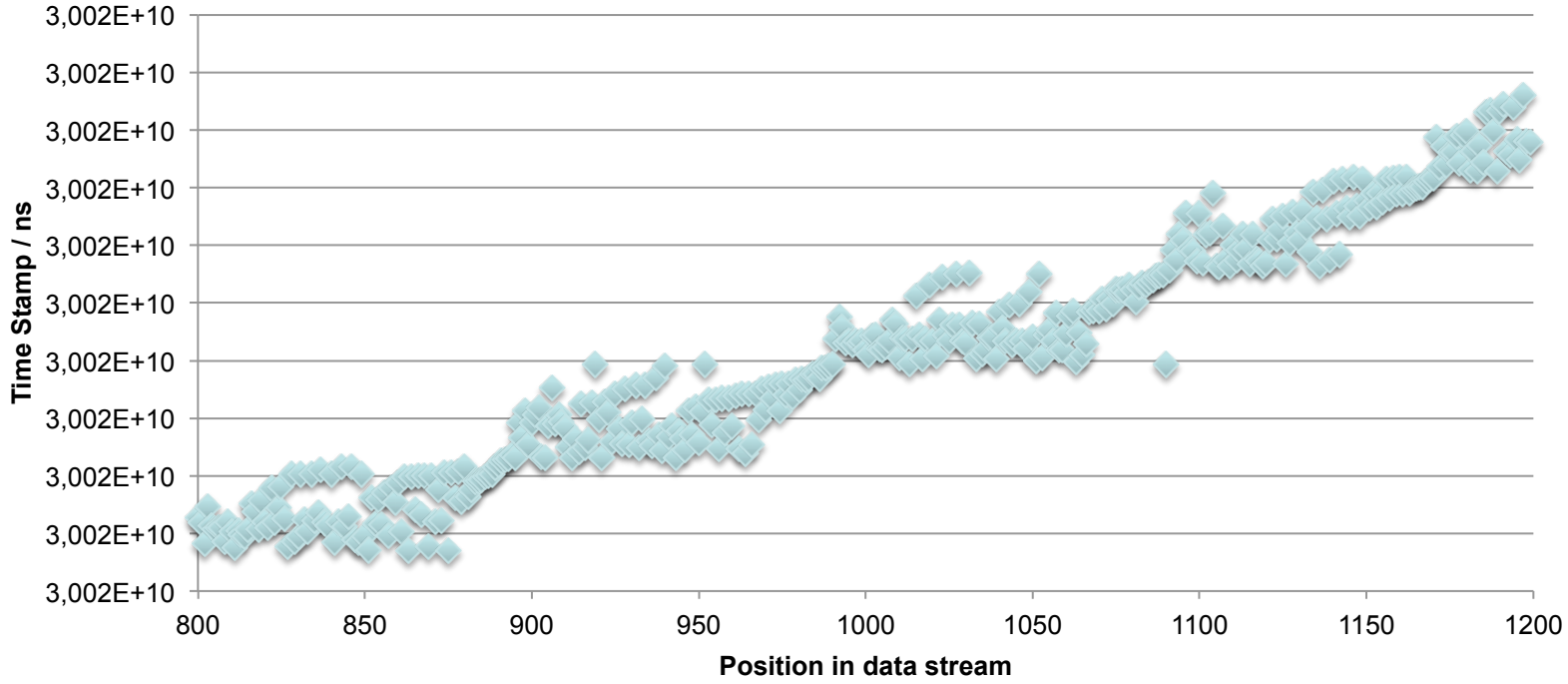
Event builder

Track finder

Summary

- Message Queues offer an easy way to parallelize data processing
- FairMQ offers abstraction layer to use e.g. ZeroMQ, nanomsg, shared memory
- Enables online data processing for test beam data
- Test of future DAQ for PANDA

Distributor



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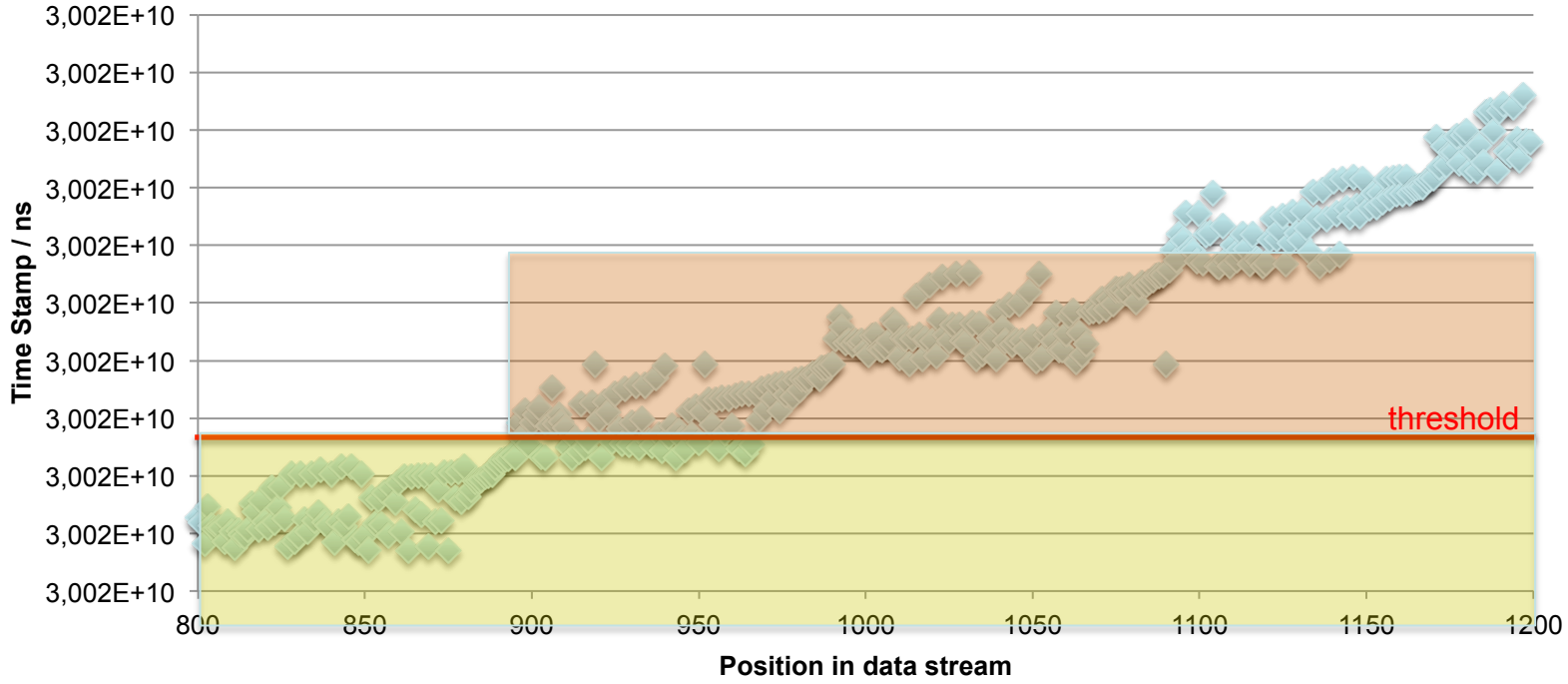

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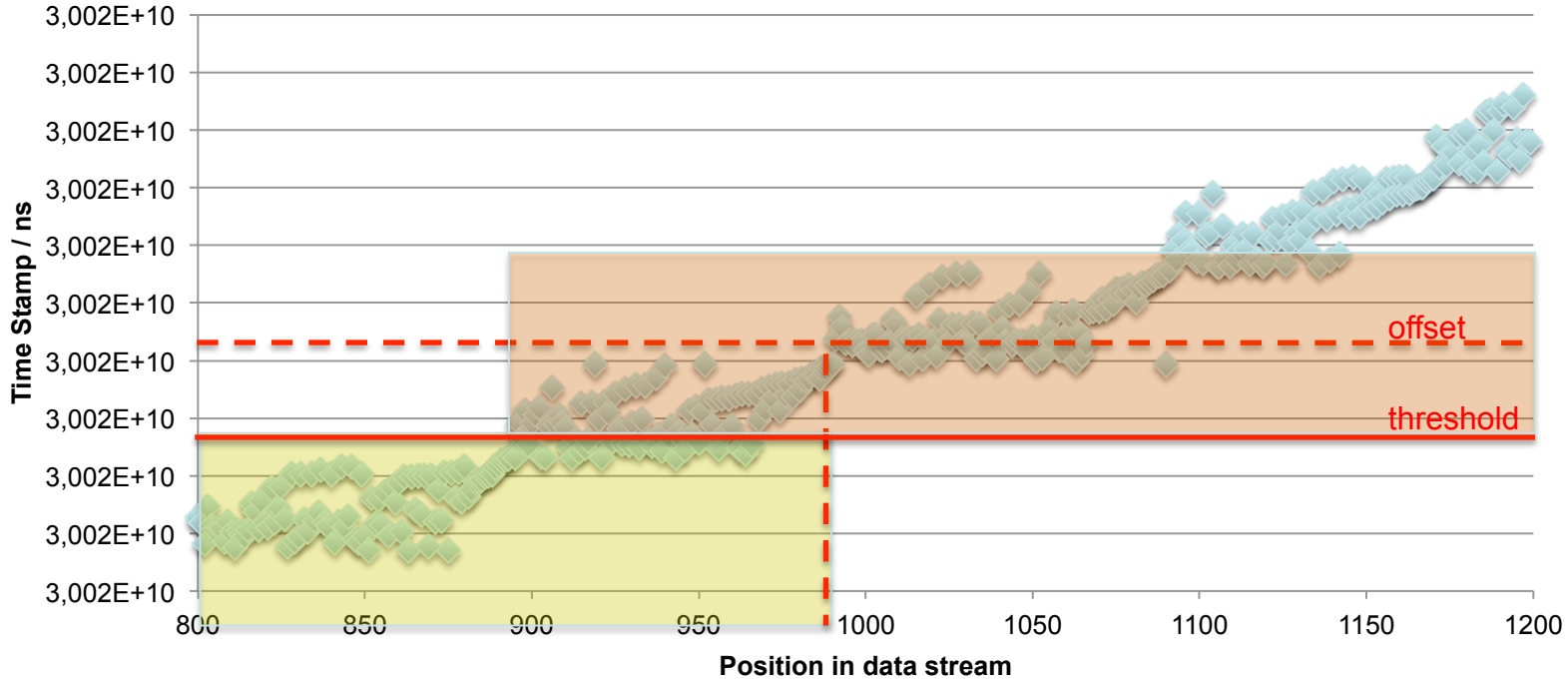

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