Reliable Monitoring for the LHCb HLT

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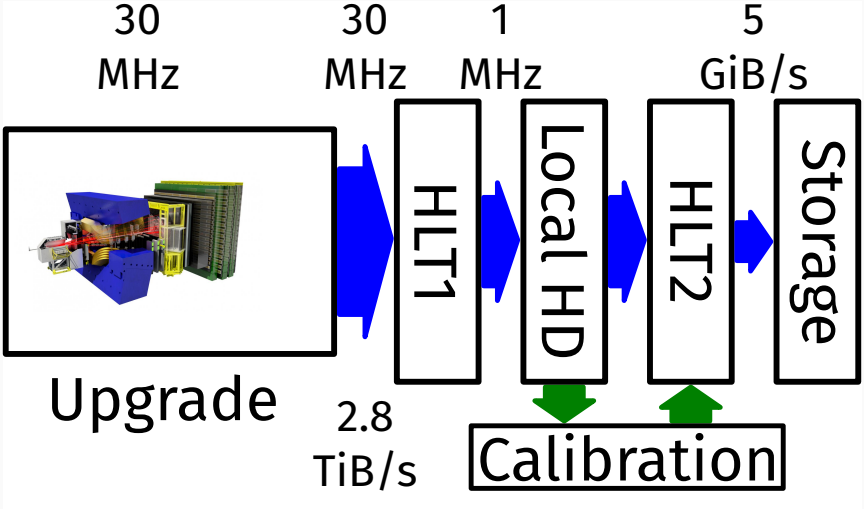
ROOT workshop, September 12th 2018

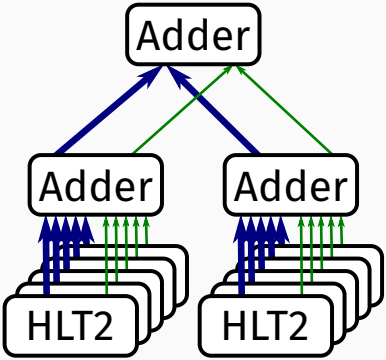

30
MHz
30
MHz
1
MHz
5
GiB/s
HLT1
Local HD
HLT2
Storage
Upgrade
2.8
TiB/s
Calibration

Boundary Conditions and Requirements

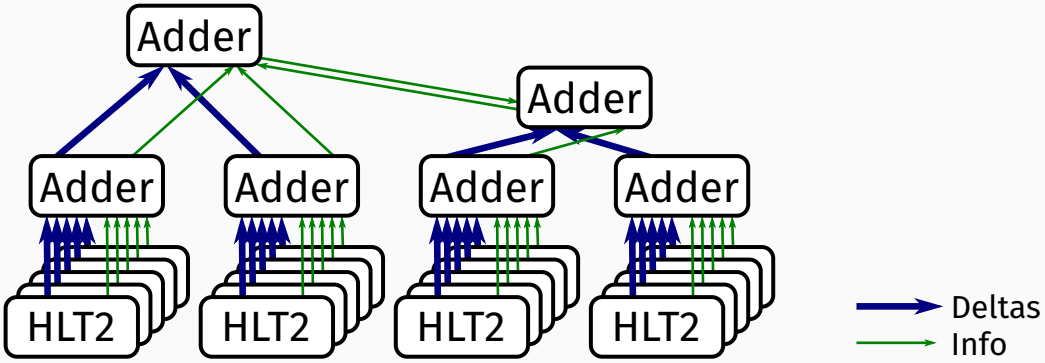
- HLT2 runs asynchronously
- Histograms should be written to ROOT files in specific locations
- O(3700) histograms per run (20 minutes on average)
- Up to 200 runs simultaneously processing
- Small resource consumption on the farm nodes
- Tasks controlled by LHCb Experiment Control System (ECS)
- Should be able to normalize rates with partially processed runs

Infrastructure

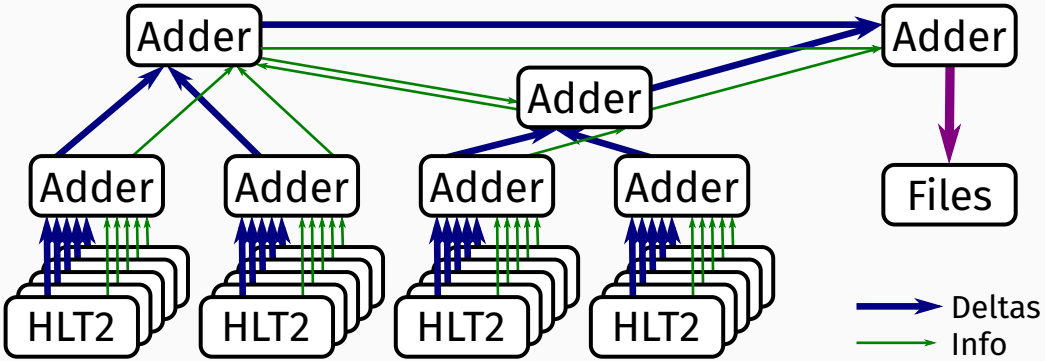
Infrastructure



Infrastructure



Infrastructure



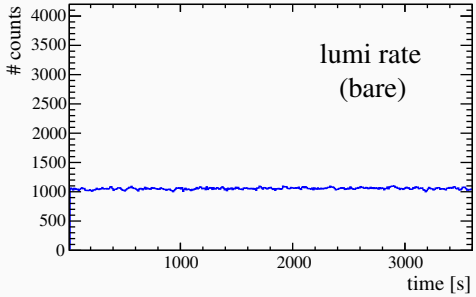
ØMQ and Boost.Serialize

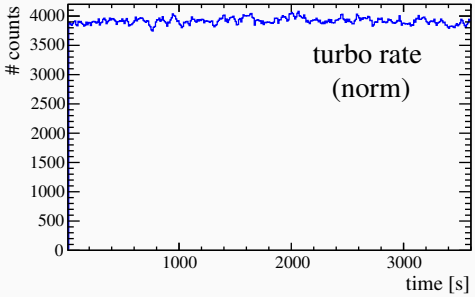
```
auto ernie = zmq::socket{ctx, ZMQ_PAIR}; ernie.bind("ipc://e_b");
auto bert = zmq::socket{ctx, ZMQ_PAIR};  bert.connect("ipc://e_b");

using some_t = std::vector<std::tuple<std::string, double, bool>>;
ernie.send(some_t{});
auto st = bert.receive<some_t>();
```

- Sending serialized ROOT histograms would be wasteful
- Use ØMQ message passing for communication:
  content agnostic, fast, scalable, excellent docs
- Boost.Serialization for serialization of non-ROOT objects
- For ROOT objects use `TBufferFile`

Normalized Rates

- Monitored rates should make sense
- Normalize to lumi events
- Get the dead time from the run DB





ROOT Part

- Histograms booked in HLT2 processes are ROOT histograms
- They should go into the files as ROOT histograms
- Write ROOT files in N threads:
  - Open existing file
  - Load histograms
  - Add deltas
  - Write new file
- Contention may be tricky, help and advice from ROOT team very useful!

Development Process

- This should not have been a one-person job
- Less hacking, more design
- Scaling is important
- So is testing
- More docs!

Closing Remarks

- It works, should also be fine for the LHCb upgrade
- Quite a bit of tuning was required
- Scalable simulator provided critical insights
- Still plenty of ideas:
  - Proper protocols, credit based
  - Monitoring the monitoring
  - Investigate alternative transport layers
- Also worked on, but didn't mention python-based automated analysis.