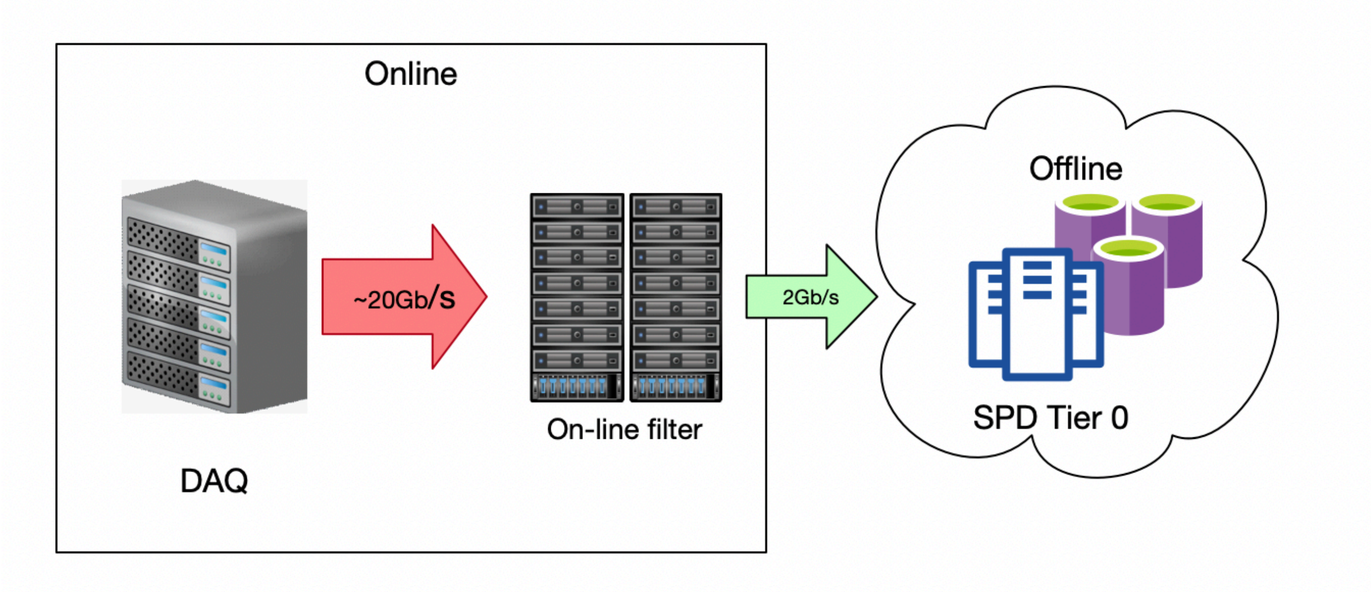
Initial concept of SPD On-Line filter

Danila Oleynik 19.10.2021

What is SPD OnLine filter?

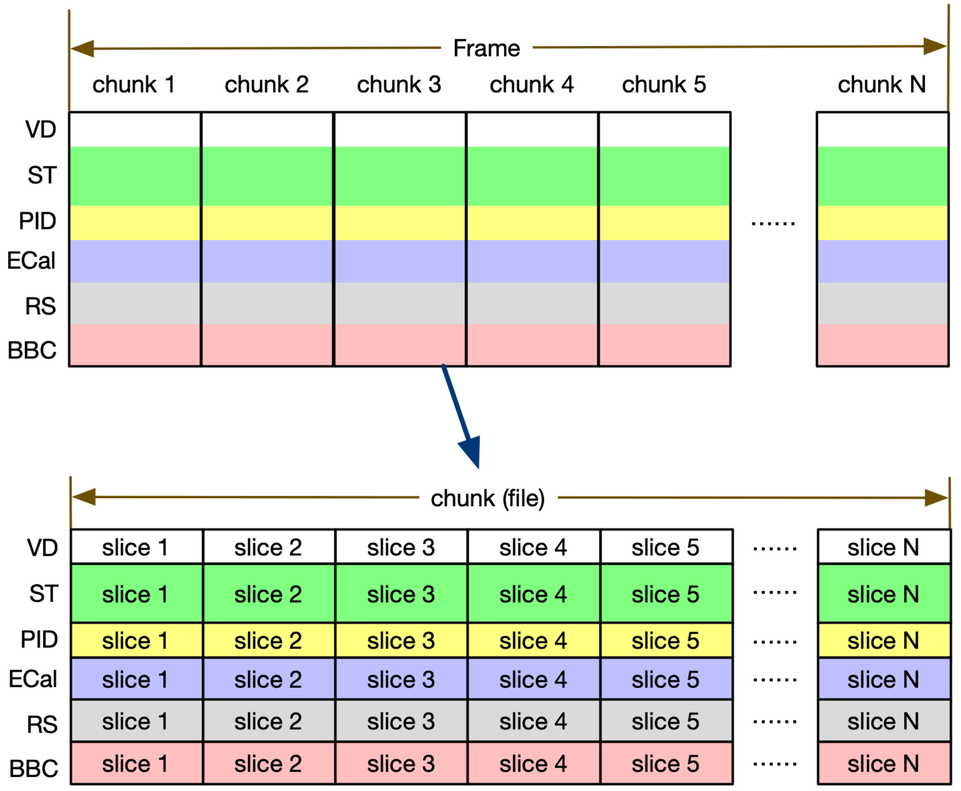
- SPD specialty – triggerless data acquisition;
- DAQ does not provide event building, but somehow arrange data from frontend electronic into time frames;
- 20 – 25Gb/s are expected data stream during data taking (noise amount not estimated yet);
- Special computing facility required to:
  - provide event building from time frames;
  - significant reduce data stream for future "offline" processing and long-term storing, by rejecting of "uninteresting" events;
  - organizing of data in sets of files for future processing.



High-throughput computing for SPD data processing

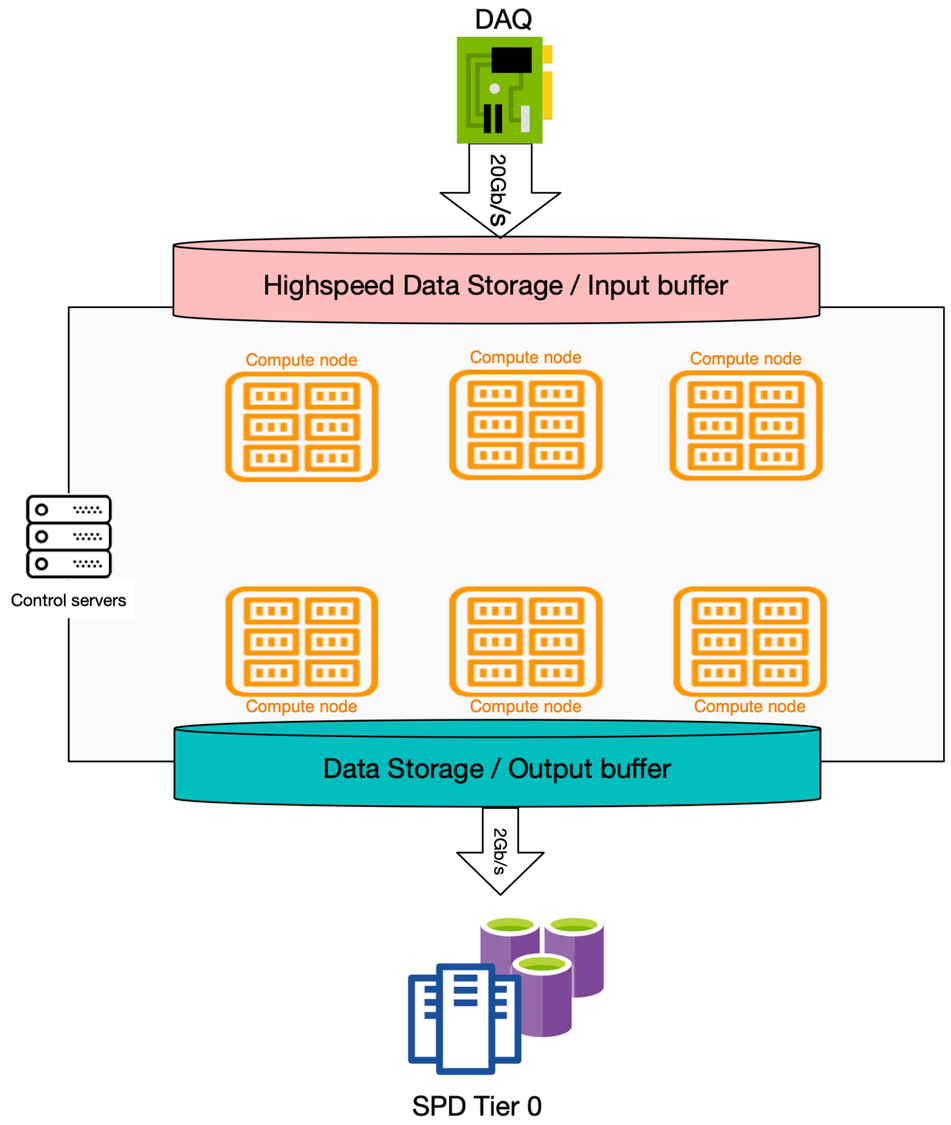
High-throughput computing (HTC) involves running many independent tasks that require a large amount of computing power.

- DAQ provide data organized in time frames and sliced to files with reasonable size (a few GB)
- Each of these file may be processed independently as a part of top-level workflow chain
- No needs to exchange of any information during handling of each initial file, but results of may be used as input for next step of processing.



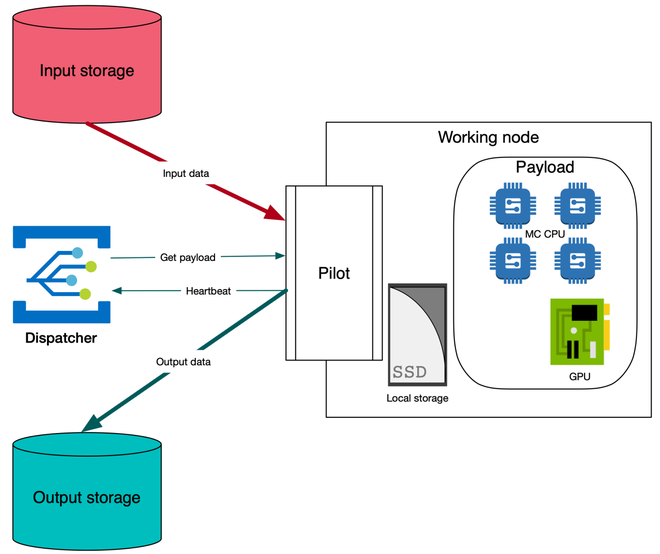
Online filter infrastructure

- *High speed (parallel) storage system for input data written by DAQ.*
- *Compute cluster with two types of units: multi-CPU and hybrid multi CPU + Neural network accelerators (GPU, FPGA etc.).*
- *A set of dedicated servers for managing of processing workflow, monitoring and other service needs.*
- *Buffer for intermediate output and for data prepared for transfer to long-term storage and future processing.*



Online filter computing facility

- *Online computing facility should provide high-throughput data processing, by managing of handling of small parts of data on each compute node.*
- *Special service, which will manage processing workflow and dispatch jobs across compute nodes is required.*
  - *Pilot - the execution environment for compute jobs*
  - *Pilot applications continuously run on each compute node*
  - *A message queue technology is going to be used for communication*



Dispatcher required functionality

Data management;

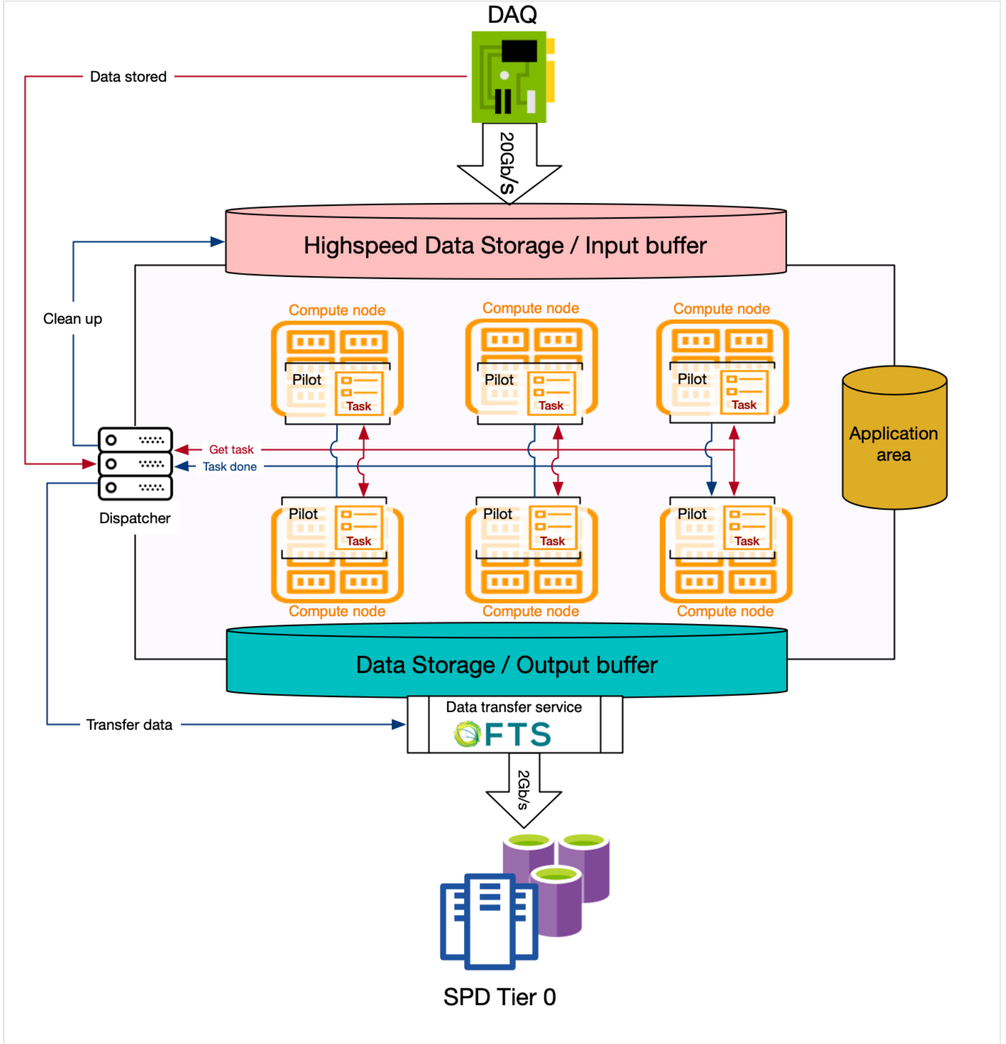
- *Support of data lifetime (registering, global transfer, cleanup);*

Processing management;

- *Generate jobs for each type of processing:*
  - *Events identification (building);*
  - *Verifying of processing results (AI vs traditional processing);*
  - *Select (Filter) events;*
  - *Pack (merge) output data for transferring to “offline”;*

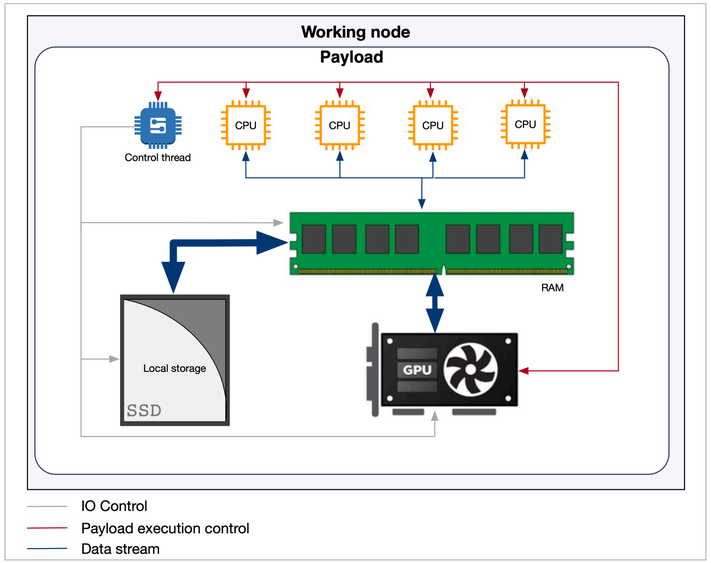
Workload management:

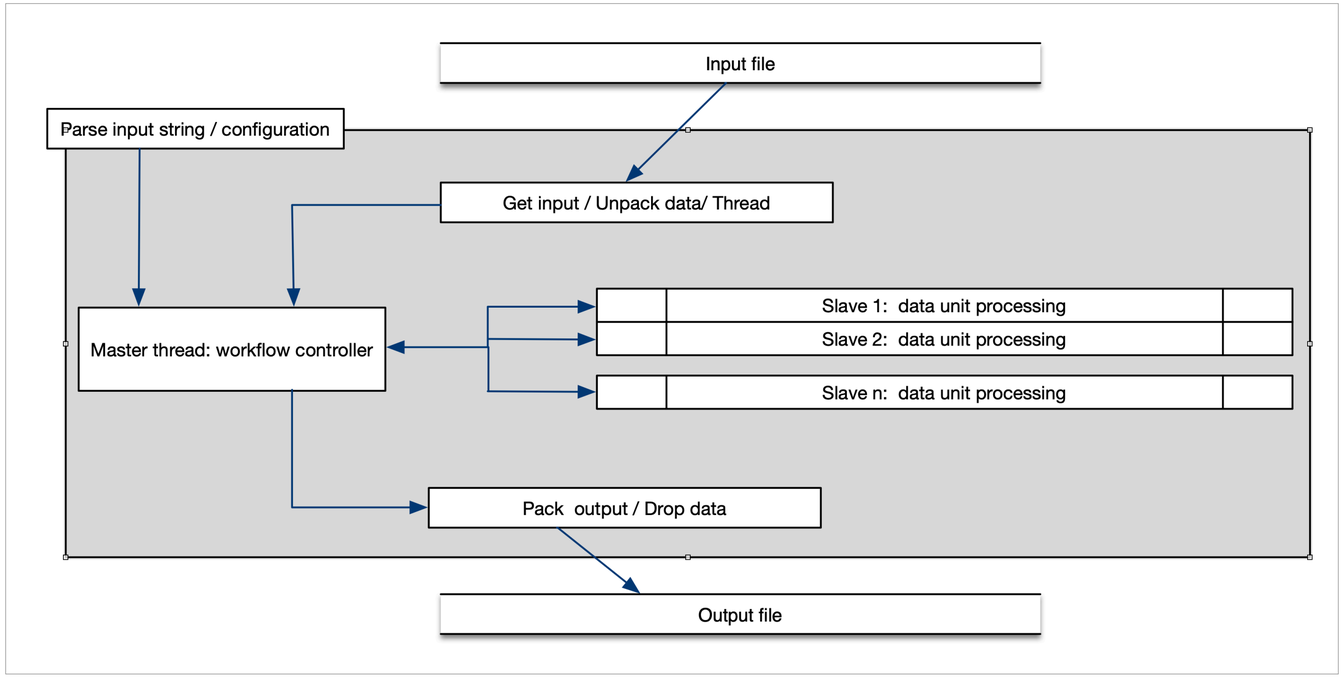
- *Dispatch jobs to pilots;*
- *Control of jobs executions;*
- *Control of pilots (identifying of "dead" pilots)*



Multithread processing

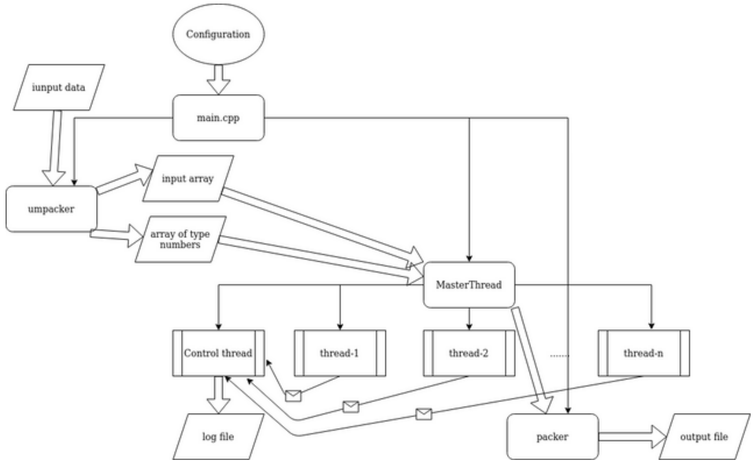
- Multicore computers already reality
  - Efficient usage requires multithreading processing
  - A lot of algorithms in HEP software stack does not support multithread execution (yet)
- We may try to explore multithread processing on data layer (each thread process own piece of data)





OnDatRa

Online Data Filter Reconstruction framework



- RnD for development of own multi-thread framework was started.
  - A very initial prototype was developed by Anna
  - In progress, researches of possibility of usage of MPI technology
- Common interfaces for particular algorithms should be defined and agreed with algorithm developers
- Crucial part is usage of machine learning based algorithms and hybrid architectures with special accelerators (GPU, FPGA)
  - Started researches as in algorithm development so for integration part
  - Ongoing estimation of related requirements
- Proper IO architecture should be at the heart of framework

Conclusions

- Basic concept of SPD Online filter is defined.
  - Flexibility, scalability and efficiency are key aims
- Already two activity for SPD online filter started
  - Infrastructure and middleware support for high-performance computing facility
    - A lot of communications with DAQ group to agreed interfaces layer, raw data organization and format
    - Prototyping of required services is launched
  - Multi-thread framework with supporting execution on hybrid architectures is highly required
    - Some prototyping started, but a lot of work to be done