DQM, Express Reco and Access to Condition DB

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1. Introduction

- Real time monitoring of the data quality is essential for the stable data taking.

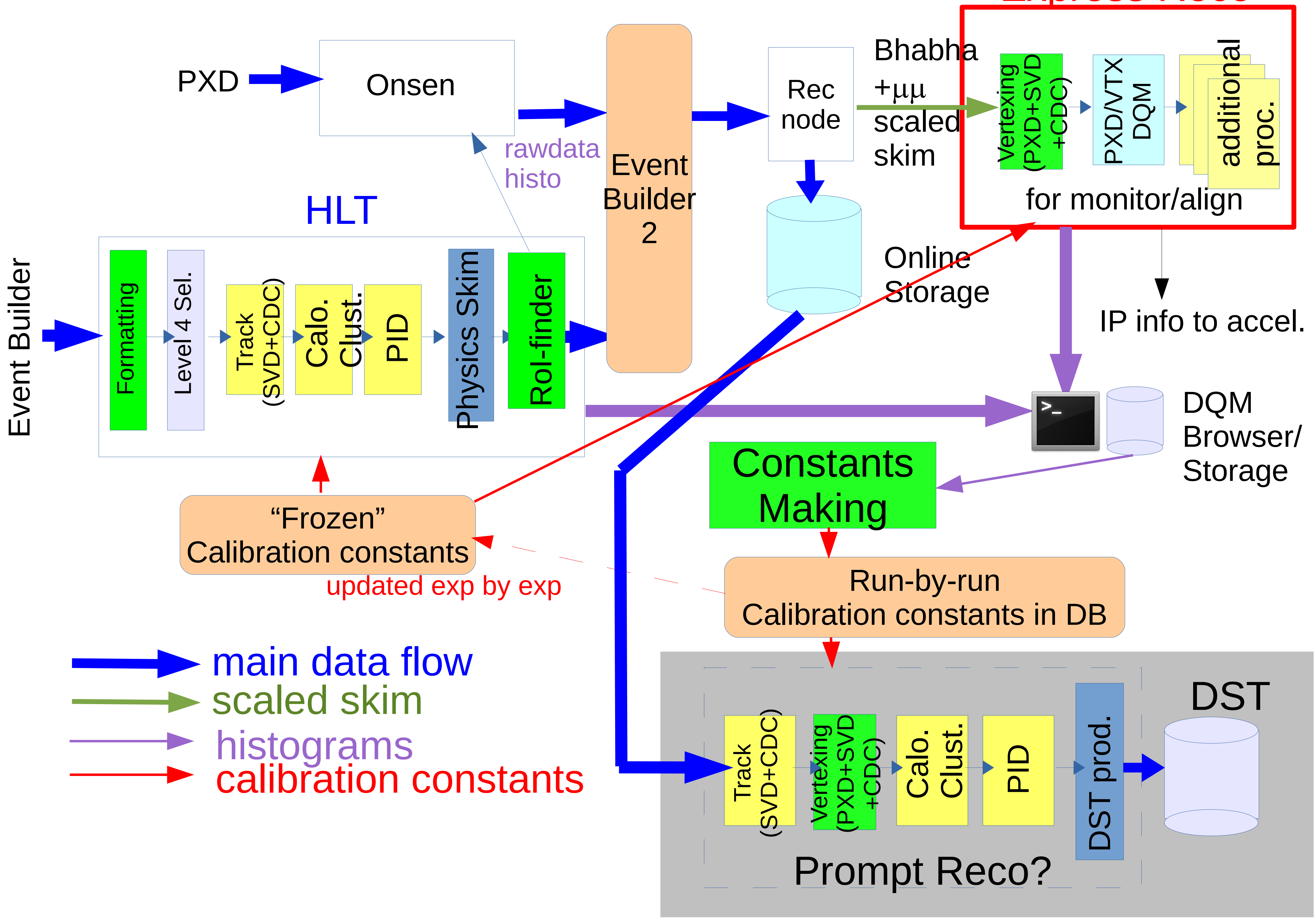
- The monitoring consists of
  * Detector performance monitor (i.e. hit-map, gain variation, etc.)
  * Physics performance monitor (i.e. momentum resolution, etc.)
  * Trigger performance (Various dist. used in L1/HLT selection)

- In Belle II DAQ, such monitoring is performed on HLT and Express Reco.

- The real time monitoring is implemented by the periodical "spy" of 1D and 2D histograms from live basf2 processes.

- At run ends, the accumulated histograms and N-tuples(TTrees) are supposed to be left on the storage for quick analysis and calibration.

Data Monitoring and Database Access



Structure of Express Reco

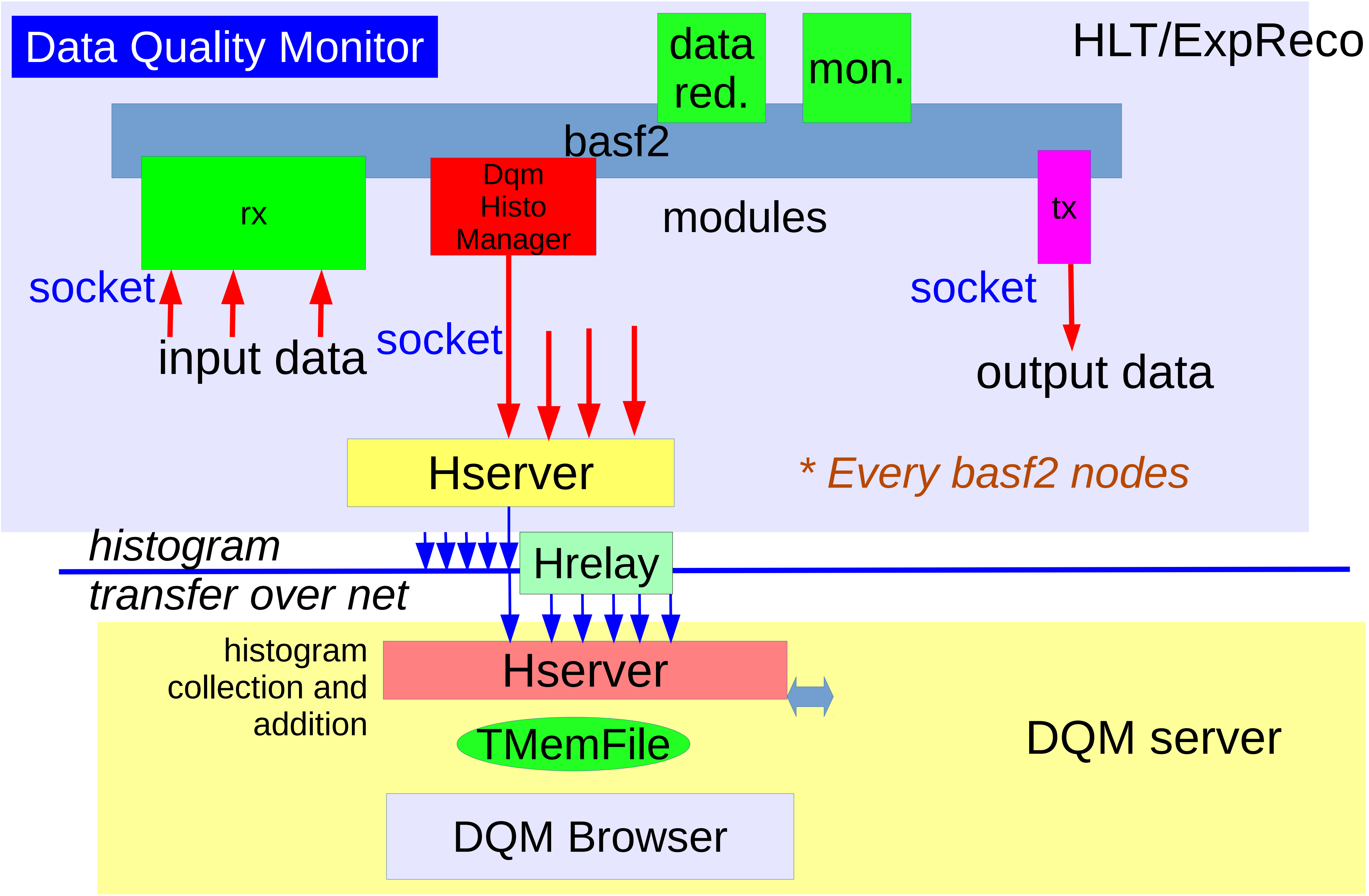
- Express Reco receives the final raw data with PXD. It is the only place to perform the full data analysis with PXD.
  - * PXD DQM is performed here.
  - * PXD+SVD+CDC tracking performance
  - * Vertex position to be sent to accelerator thru. NSM

- Express Reco has the similar structure to that of HLT.
  - * Consists of multiple units (at least 2 units for backup).
  - * A unit consists of a number of processing nodes (up to 10).
  - * The same HLT software framework is implemented.
  - * The difference is it racks output collection node and cannot record the processing results in output disk except for Histograms/Tuples collected for DQM.

- The total CPU power of Express Reco is supposed to be 1/10 of HLT's in the draft design. -> Could be changed by looking at the actual CPU consumption by the full tracking with PXD.

- The data fed into ExpressReco are sampling basis.
  - * Rate can be modified, but basically “as much as possible”
  - * Sampling is done by looking at the HLT tag.

Data Quality Monitor



* Hserver adds up the same histograms collected from multiple processes/nodes.

DqmHistoManager module : Update

- The module is compatible with HistoManager module.

- The definition of all ROOT histograms/Tuples/Trees is centralized to this module and the accumulated contents are dumped to network socket from each event process in addition to files.

- The dump is done at every preset event number interval.

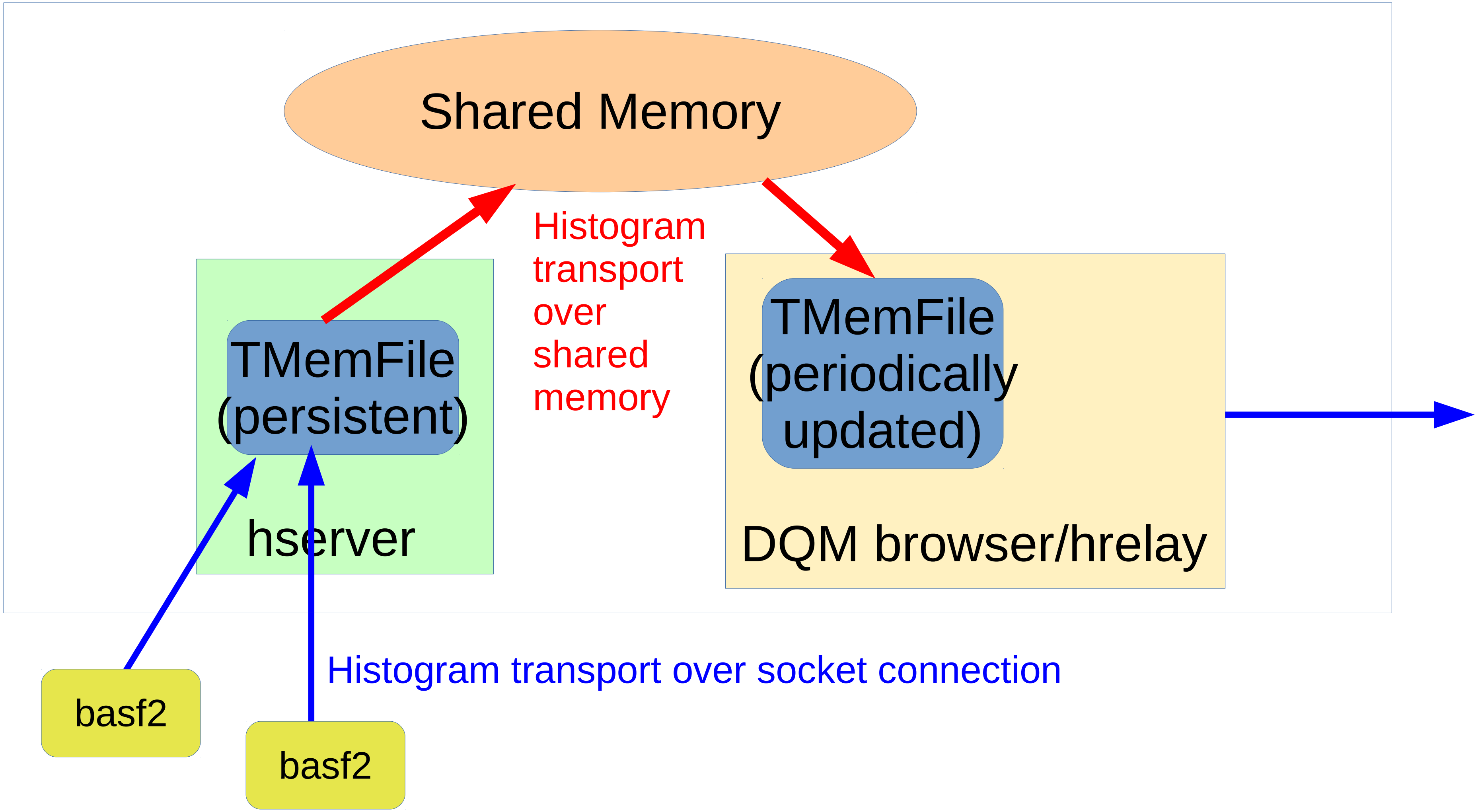
- Only 1D/2D histograms are transferred to hserver at the dump while all histograms/tuples/trees are dumped in files.

- The 1D/2D histograms can be lively viewed by DQM browser.

- At the run end, the histograms/ tuples/trees files at last dump are collected and merged to a single file/ HLT unit.

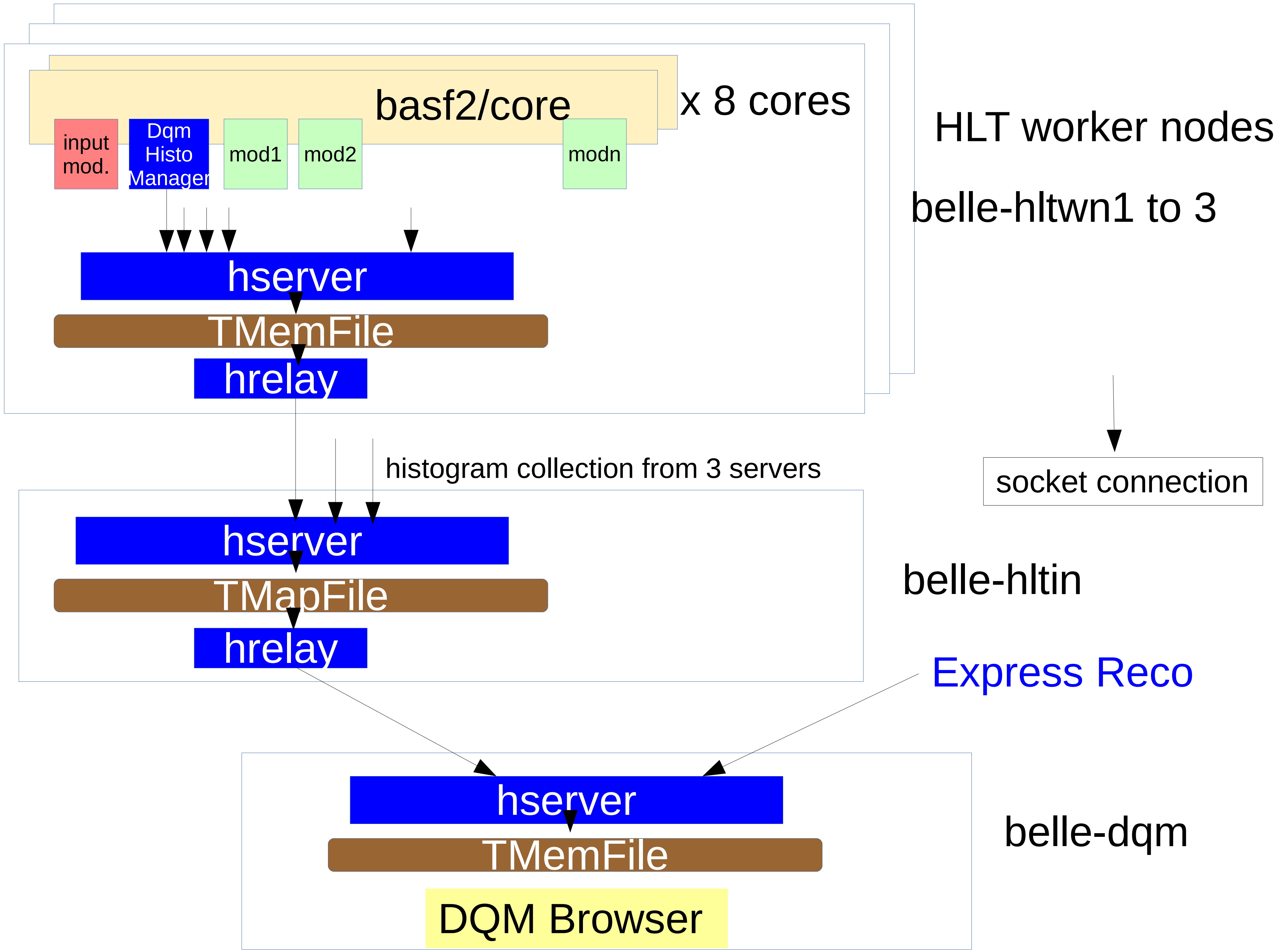
    -> to be used for the constants-making.

New histogram transport with TMemFile


Shared Memory
Histogram transport over shared memory
TMemFile (persistent)
hserver
TMemFile (periodically updated)
DQM browser/hrelay
basf2
basf2
Histogram transport over socket connection

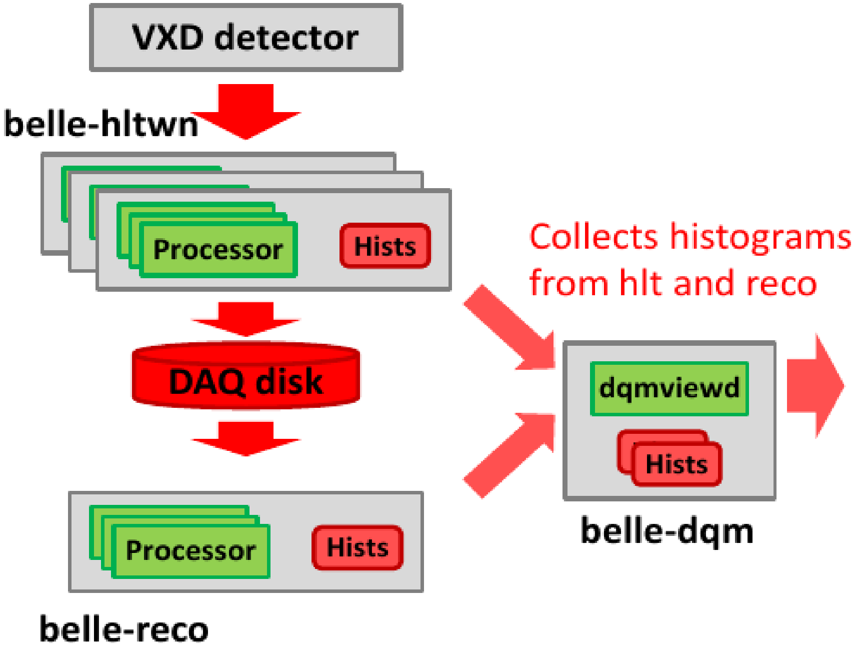
- Former TMapFile was replaced with this new method.

Histogram Collection for DQM in DESY-TB DAQ

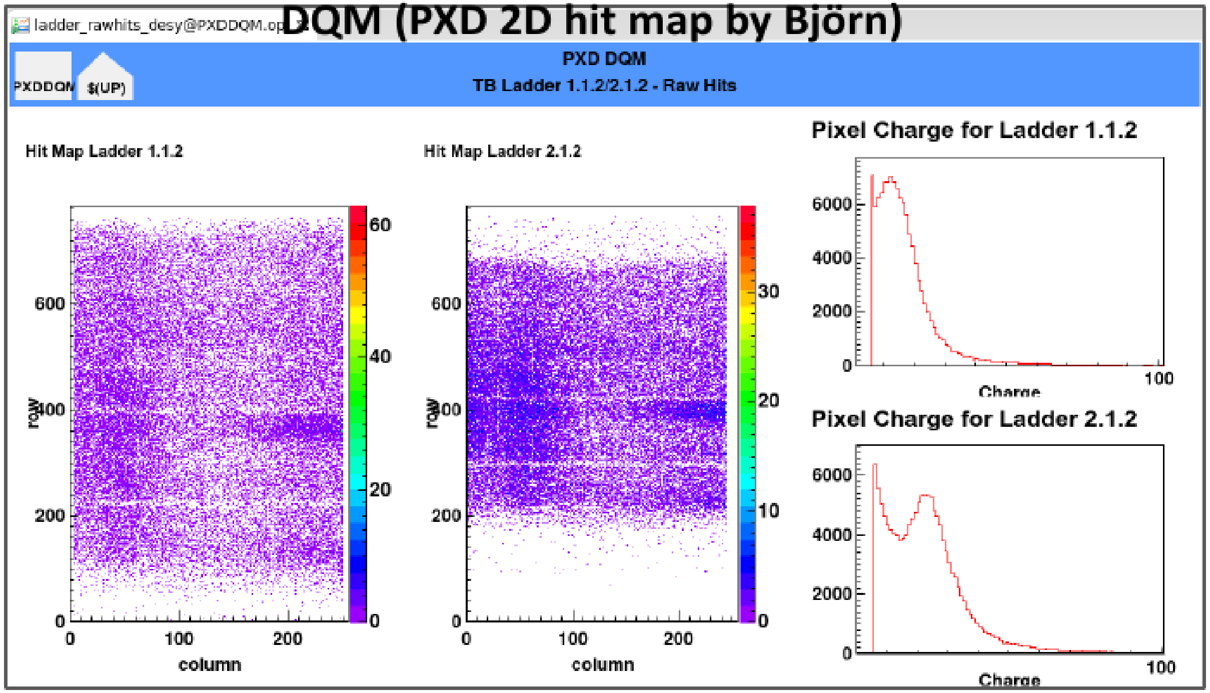


T.Konno

Data Quality Monitor viewer



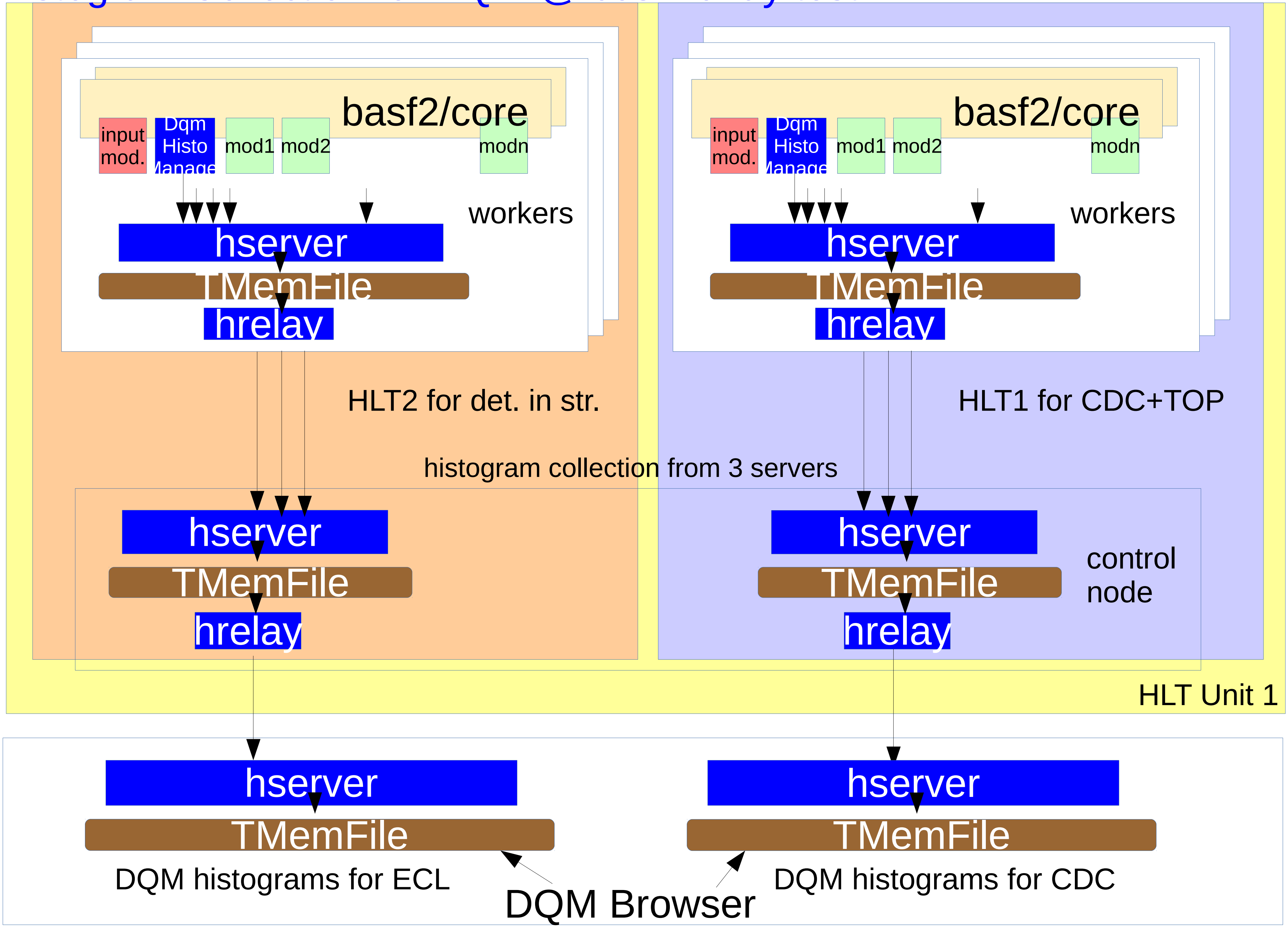
DQM (PXD 2D hit map by Björn)


ladder_rawhits_desy@PXDDQM.op
PXDDQM
$(UP)
PXD DQM
TB Ladder 1.1.2/2.1.2 - Raw Hits
Hit Map Ladder 1.1.2
Hit Map Ladder 2.1.2
row
column
0
100
200
200
400
600
0
20
40
60
0
10
20
30
Pixel Charge for Ladder 1.1.2
Pixel Charge for Ladder 2.1.2
Charge
0
2000
4000
6000
100

- DQM : online data checker to generate histograms
  - SVD: Hit map, charge distributions and reconstructed track
  - PXD: channel hit maps (2D and 1D), charge distributions
- DQM viewer is now merged into CSS UI
  - PXD group provided nice DQM panels to show various histograms

All control/monitor GUIs in Belle II DAQ are unified

Histogram Collection for DQM @ cosmic ray test



basf2/core

input mod.

Dqm Histo Manage

mod1

mod2

modn

workers

hserver

TMemFile

hrelay

HLT2 for det. in str.

basf2/core

input mod.

Dqm Histo Manage

mod1

mod2

modn

workers

hserver

TMemFile

hrelay

HLT1 for CDC+TOP

histogram collection from 3 servers

hserver

TMemFile

hrelay

hserver

TMemFile

hrelay

control node

HLT Unit 1

hserver

TMemFile

DQM histograms for ECL

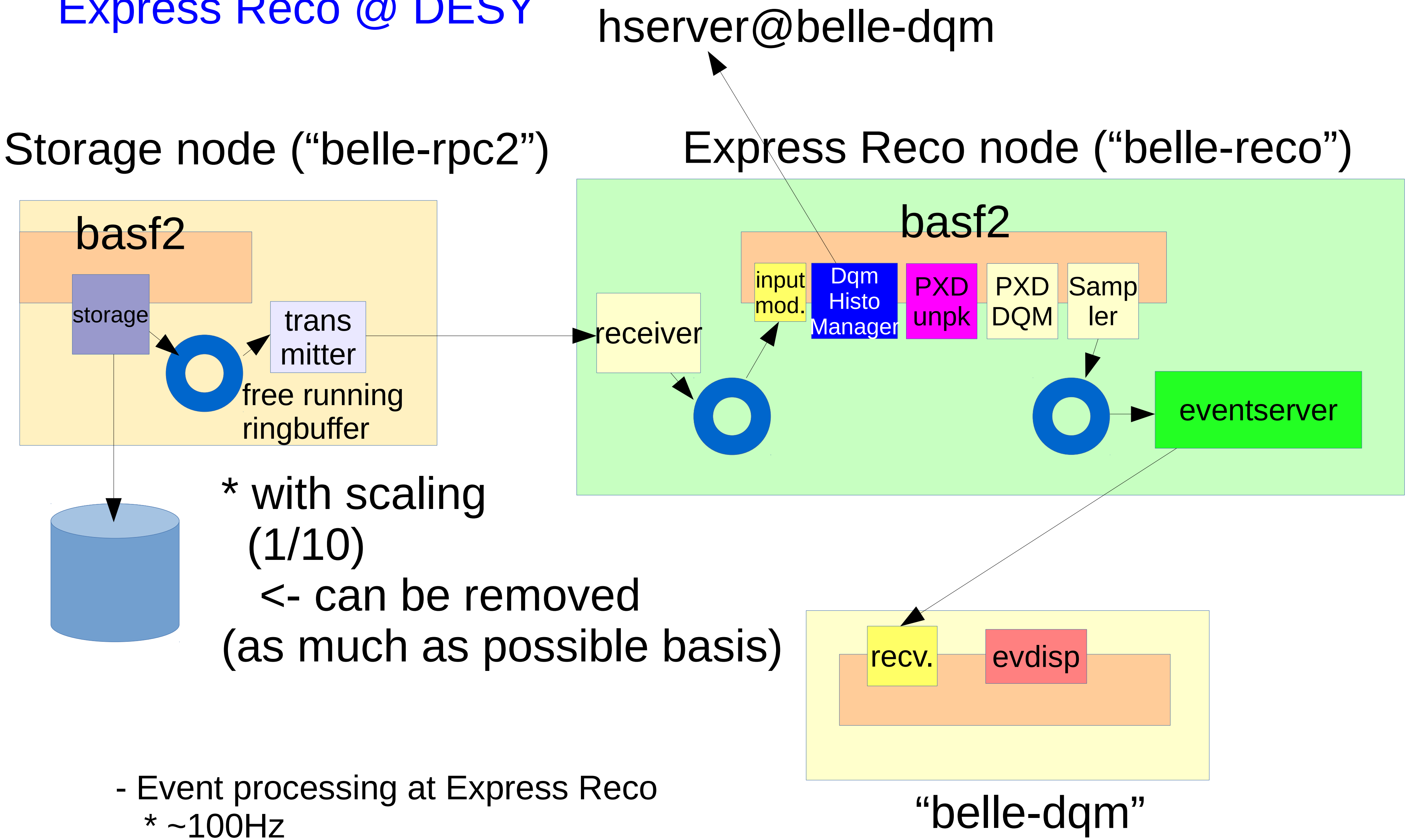
hserver

TMemFile

DQM histograms for CDC

DQM Browser

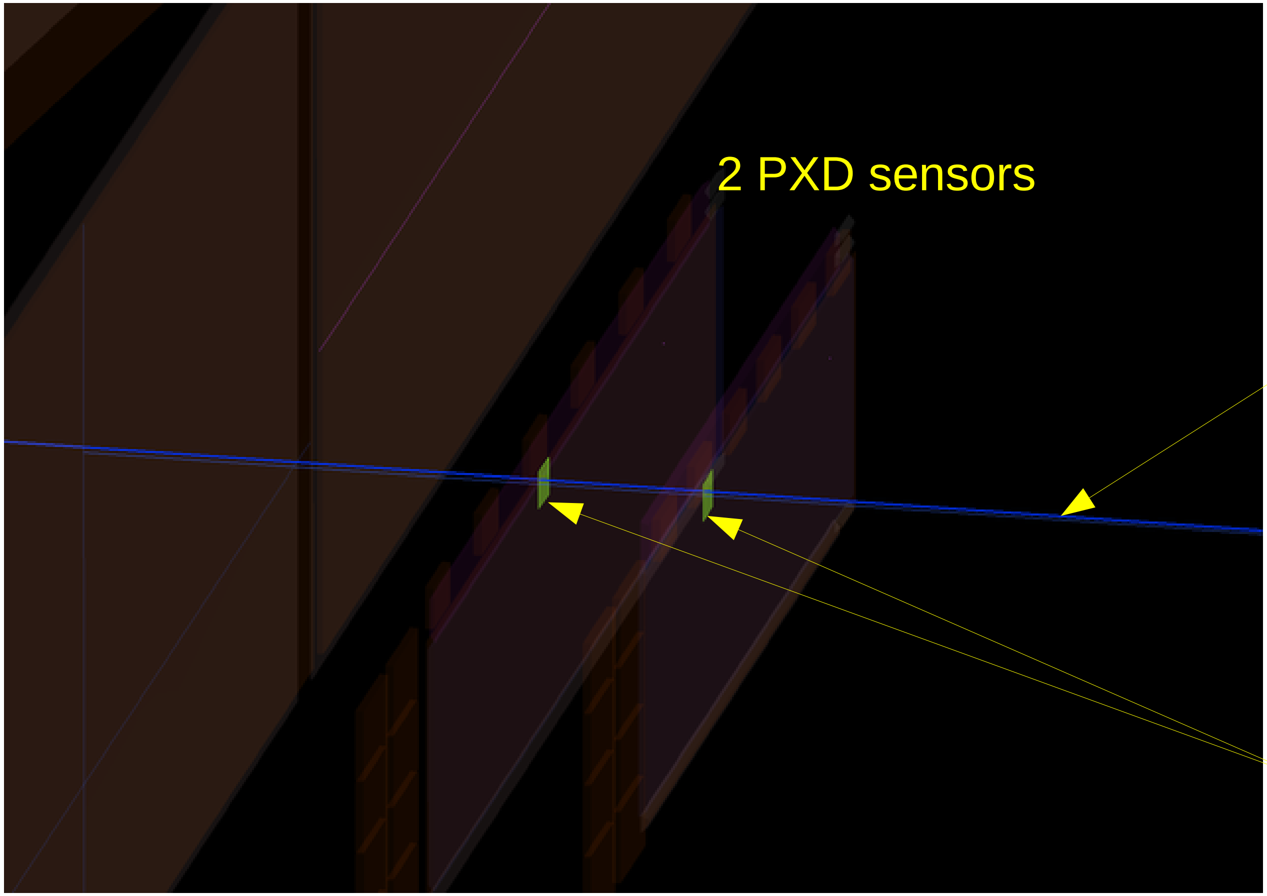
Express Reco @ DESY



* with scaling
(1/10)
<- can be removed
(as much as possible basis)

- Event processing at Express Reco
  - * ~100Hz
  - * Simple PXD monitoring only
    - -> more complex monitoring with PXD+SVD tracking was possible, but no time remained to make it work.

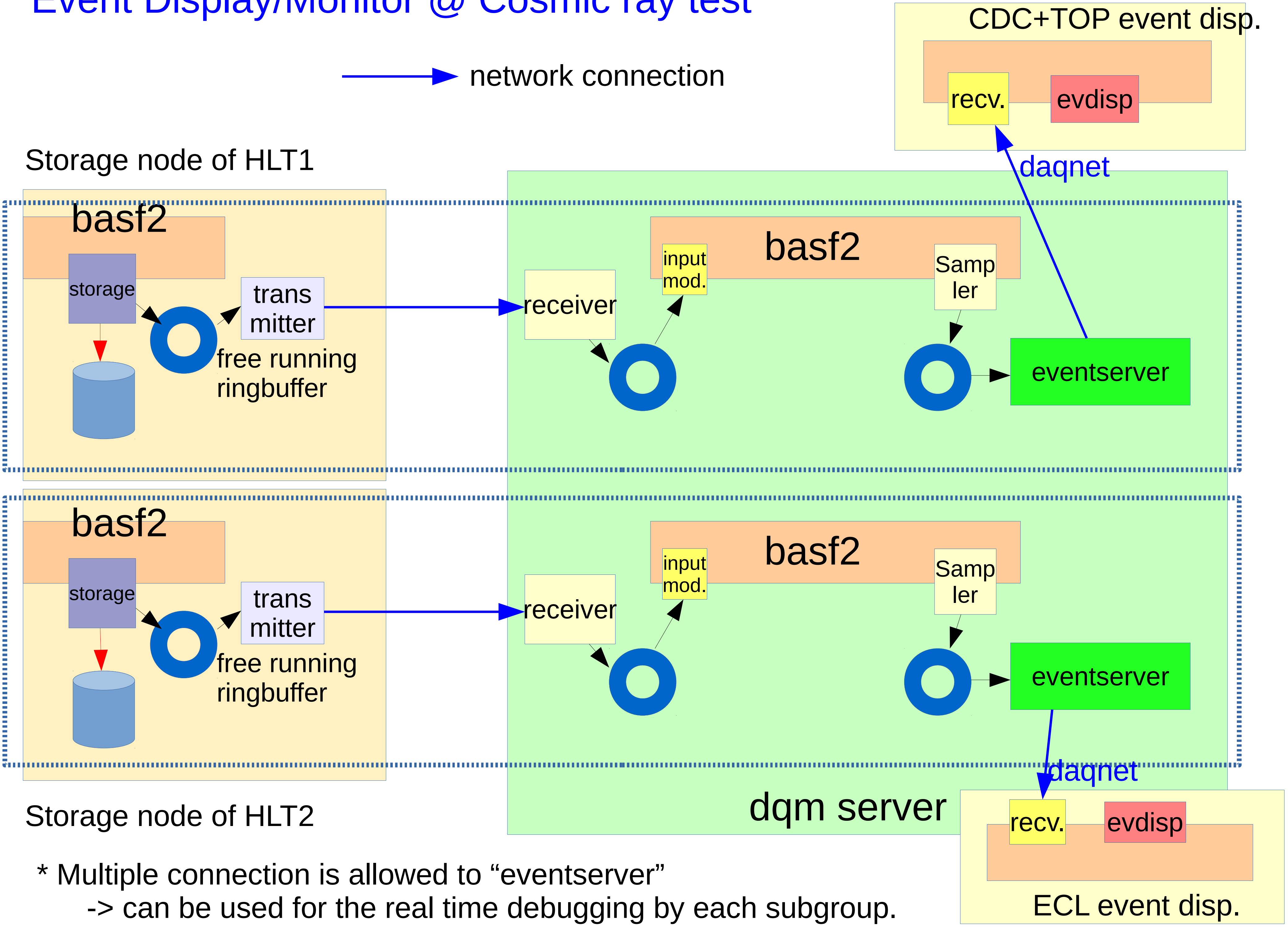
Real Time Event Display



track reconstructed by HLT

RoIs obtained from tracks

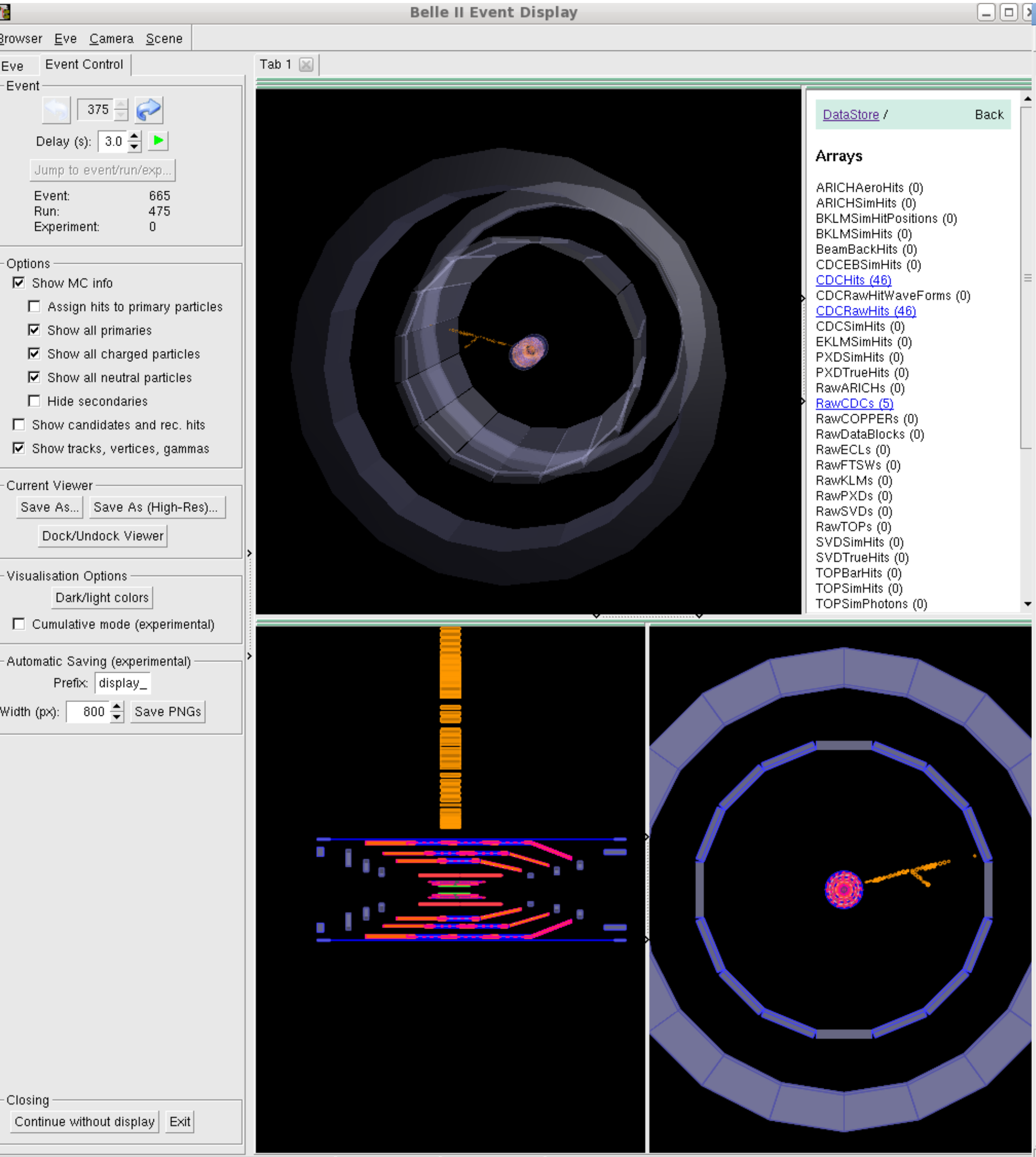
Event Display/Monitor @ Cosmic ray test



* Multiple connection is allowed to “eventserver”
-> can be used for the real time debugging by each subgroup.

Live CDC event display

- Full readout chain confirmed to work:
  FEE->COPPER->Readout PC-> HLT processing (Unpacker)
  -> Storage(sampling) -> Express Reco -> evdisp



Event
375
Delay (s): 3.0

Event: 665
Run: 475
Experiment: 0

Options
☑ Show MC info
□ Assign hits to primary particles
☑ Show all primaries
☑ Show all charged particles
☑ Show all neutral particles
□ Hide secondaries
□ Show candidates and rec. hits
☑ Show tracks, vertices, gammas

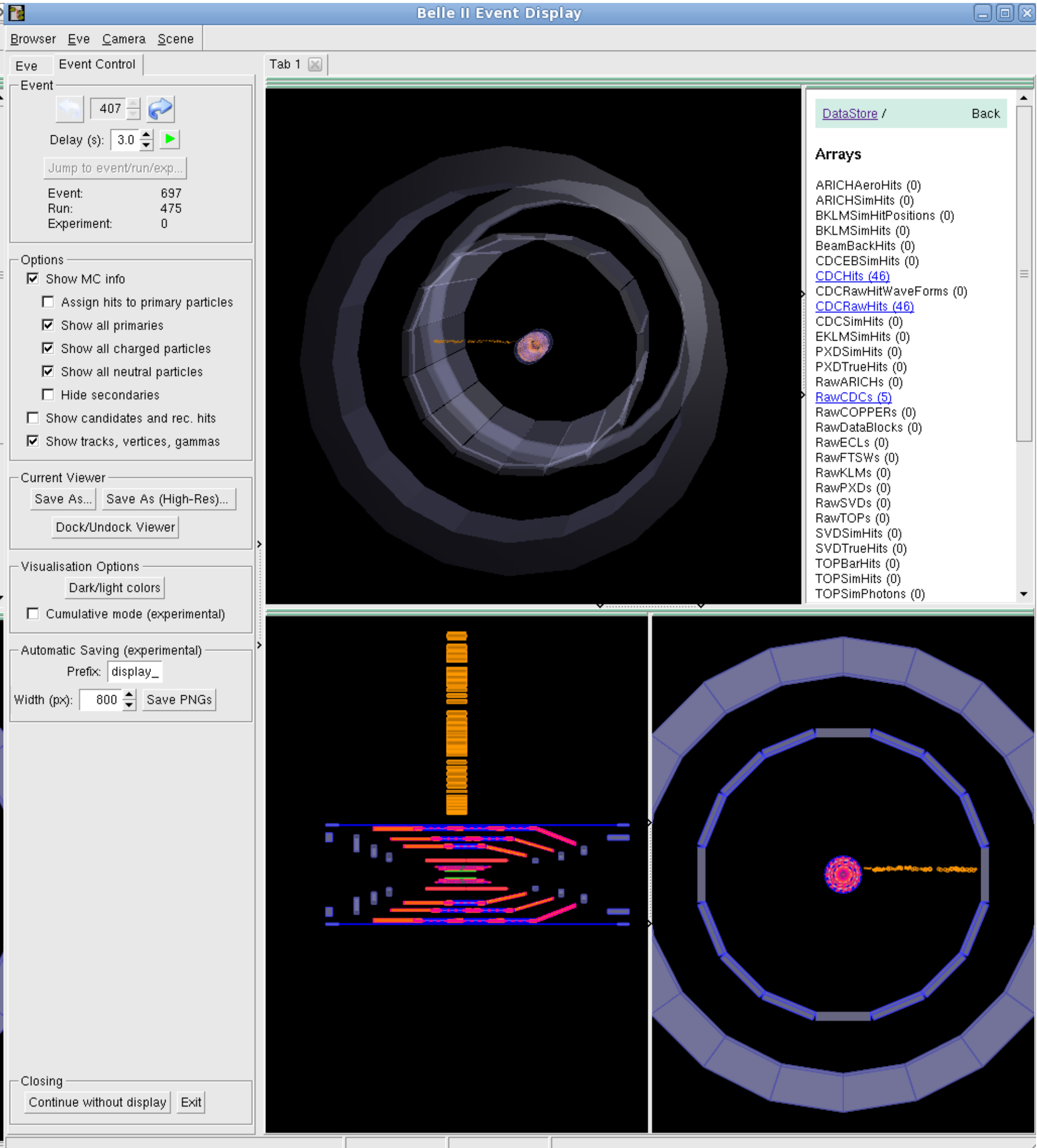
Current Viewer

Visualisation Options
□ Cumulative mode (experimental)

Automatic Saving (experimental)
Prefix: display_
Width (px): 800

Closing

Arrays
ARICHAeroHits (0)
ARICHSimHits (0)
BKLMSimHitPositions (0)
BKLMSimHits (0)
BeamBackHits (0)
CDCEBSimHits (0)
CDCHits (46)
CDCRawHitWaveForms (0)
CDCRawHits (46)
CDCSimHits (0)
EKLMSimHits (0)
PXDSimHits (0)
PXDTrueHits (0)
RawARICHs (0)
RawCDCs (5)
RawCOPPERs (0)
RawDataBlocks (0)
RawECLs (0)
RawFTSWs (0)
RawKLMs (0)
RawPXDs (0)
RawSVDs (0)
RawTOPs (0)
SVDSimHits (0)
SVDTrueHits (0)
TOPBarHits (0)
TOPSimHits (0)
TOPSimPhotons (0)



Event
407
Delay (s): 3.0

Event: 697
Run: 475
Experiment: 0

Options
☑ Show MC info
□ Assign hits to primary particles
☑ Show all primaries
☑ Show all charged particles
☑ Show all neutral particles
□ Hide secondaries
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BeamBackHits (0)
CDCEBSimHits (0)
CDCHits (46)
CDCRawHitWaveForms (0)
CDCRawHits (46)
CDCSimHits (0)
EKLMSimHits (0)
PXDSimHits (0)
PXDTrueHits (0)
RawARICHs (0)
RawCDCs (5)
RawCOPPERs (0)
RawDataBlocks (0)
RawECLs (0)
RawFTSWs (0)
RawKLMs (0)
RawPXDs (0)
RawSVDs (0)
RawTOPs (0)
SVDSimHits (0)
SVDTrueHits (0)
TOPBarHits (0)
TOPSimHits (0)
TOPSimPhotons (0)

DQM codes / Event Display required in coming GCR/Phase II

- Up to now, we have
  * Limited (and unofficial) detector performance DQM for CDC and ECL.
  * (Stand-alone version of) ECL event display, which worked partially, though.
  * CDC event display is based on the Belle2's starndard evdisp which accepts raw data unpacker results.
  * ECL raw data unpacker was still not available, and the common event display cannot be used.

- What we need in coming GCR/Phase II
  * Raw data unpackers for installed detectors, which are tested with local Pocket DAQ data beforehand.
  * Detector DQM codes using the output of raw data unpackers.
  * In addition, cosmic ray reconstruction codes (CDC tracking, ECL clustering......) and their monitoring DQM modules.

- All the codes have to be registered in Belle II software repository.

Access to Condition Database from HLT and Express Reco

Three kinds of database

1. Configuration database

Database to manage various configuration in Belle II detector parameters for DAQ

* Setting of detector front end parameters

* DAQ configuration

2. Logging database

* Various DAQ messages during data taking

* Environmental records (temperature, pressusre, radiation level)

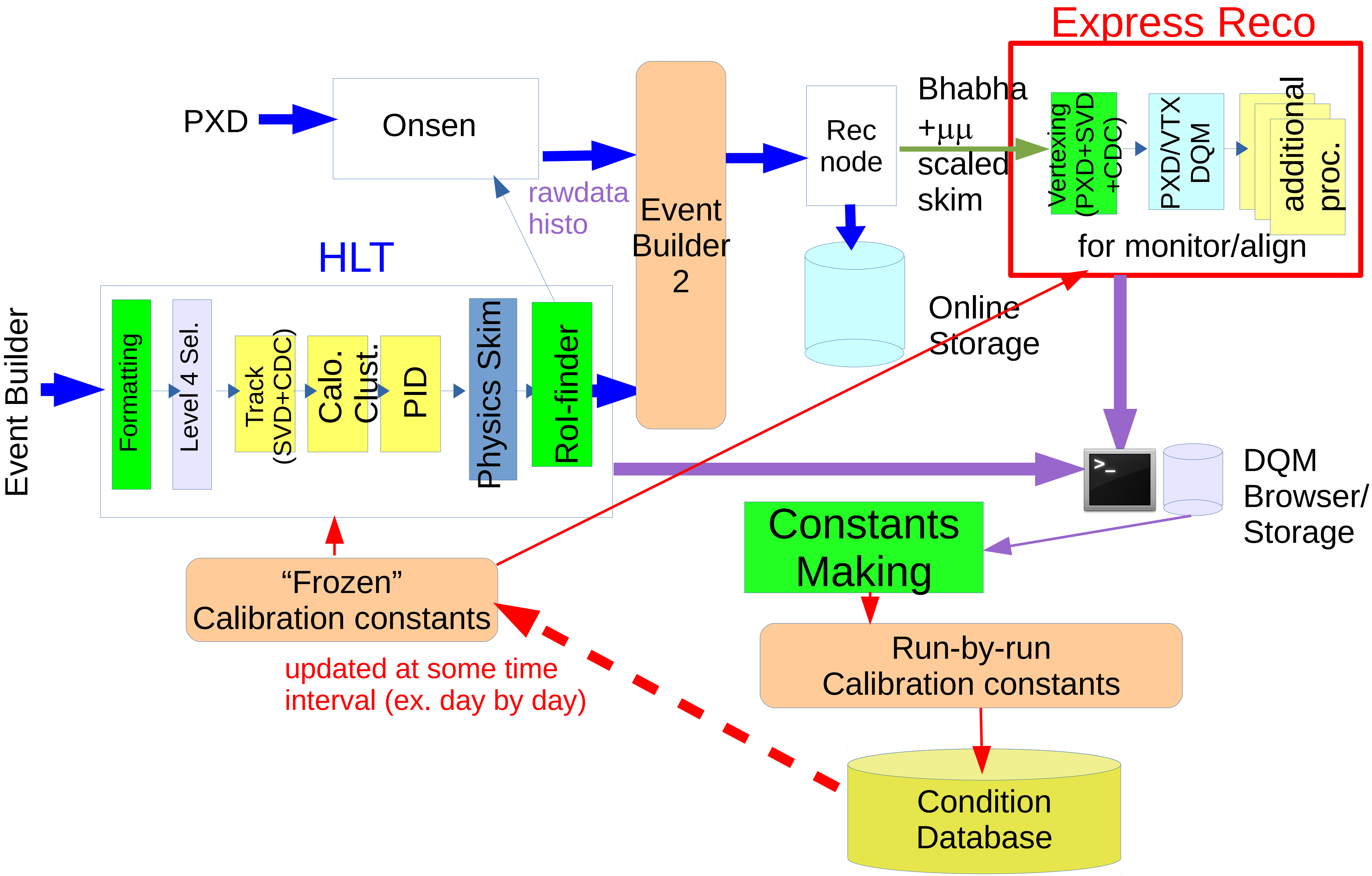
* Accelerator condition

These are filled by DAQ and retrieved in both DAQ and Offline

3. Condition (Calibration) database

* Various calibration constants to be used for the detector reconstruction

Filled in offline analysis and ported to DAQ (HLT and ExpressReco)



Express Reco

PXD

Onsen

rawdata
histo

Event
Builder
2

Rec
node

Bhabha
+μμ
scaled
skim

Vertexing
(PXD+SVD
+CDC)

PXD/VTX
DQM

additional
proc.

for monitor/align

HLT

Event Builder

Formatting

Level 4 Sel.

Track
(SVD+CDC)

Calo.
Clust.

PID

Physics Skim

RoI-finder

Online
Storage

DQM
Browser/
Storage

Constants
Making

"Frozen"
Calibration constants

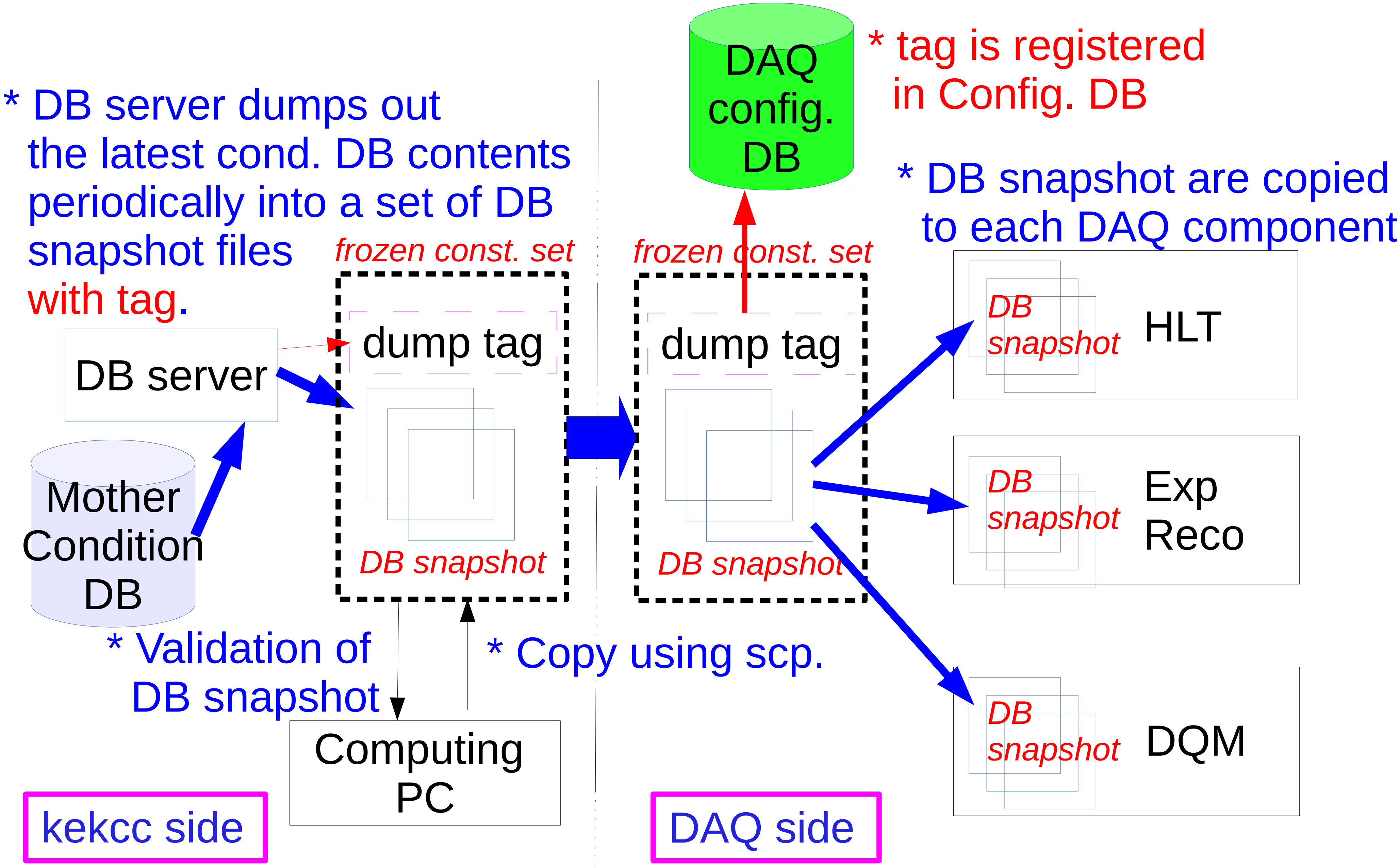
updated at some time
interval (ex. day by day)

Run-by-run
Calibration constants

Condition
Database

Current Idea to migrate conditional DB in DAQ

- Snapshot file based management of “frozen constants”



* DB server dumps out the latest cond. DB contents periodically into a set of DB snapshot files with tag.

* tag is registered in Config. DB

* DB snapshot are copied to each DAQ component

* Validation of DB snapshot

* Copy using scp.

- DB snapshot dump was already implemented as a Text or a ROOT file
- Can be read as a local database.

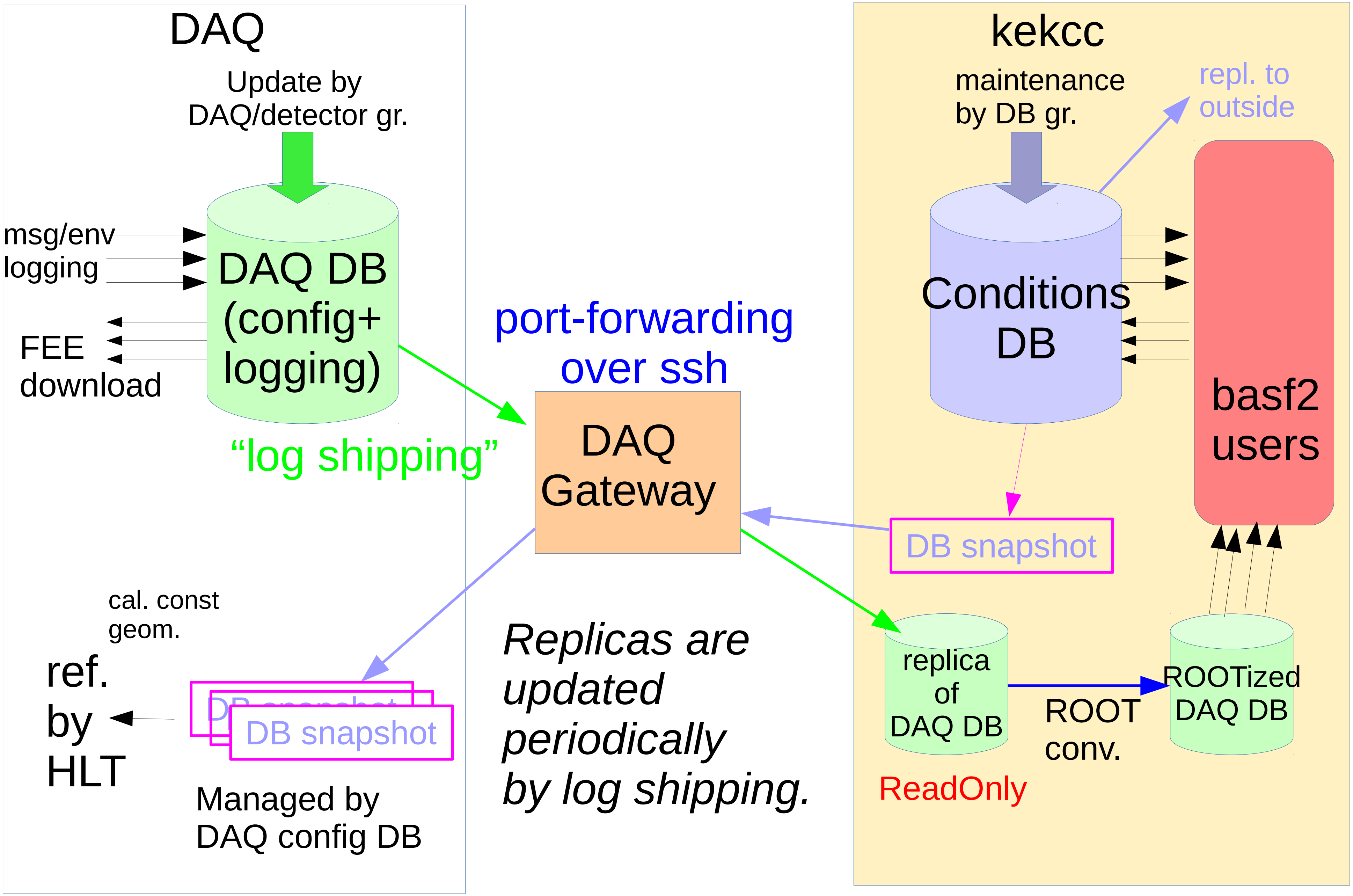
basf2 script

```
# Local database access
reset_database()
databasefile = Belle2.FileSystem.findFile("data/framework/database.txt")
use_local_database(databasefile, os.path.dirname(databasefile), True)
```

This sets up the local database access and all the DB access in HLT processing is redirected to the access to the snapshot file.

Replication of DB between DAQ and offline

Shown at Computing WS in Nov. 2013



Replicas are updated periodically by log shipping.

- Still many unclear issues in migration of condition DB:

* Frequency of database migration to HLT
-> Once per day is enough?
Constants are really availabe in a day?

* How to book-keep the HLT database payload?
-> should be managed by config DB

* Format of HLT database payload. Text? ROOT? ....

* DAQ<->Offline gateway. Direct connection is possible?
-> Yamagata-san is preparing.

Sorry, no summary.....