ATLAS High Level Trigger Monitoring

Outline

- Operational Monitoring Display of TDAQ and HLT (OMD)
- HLT Trigger Rate Monitoring and display (HLTpresenter)
- DQ monitoring on HLT

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Operational Monitoring Display (OMD)

ATLAS Trigger and DAQ: data flow on complex, distributed system

gather and display information on operational status of T/DAQ
quickly identify possible problems related with T/DAQ infrastructure

examples :

- CPU utilization
- available disk space on nodes
- # active nodes
- number of events processed / time
- average processing time/event
- event size

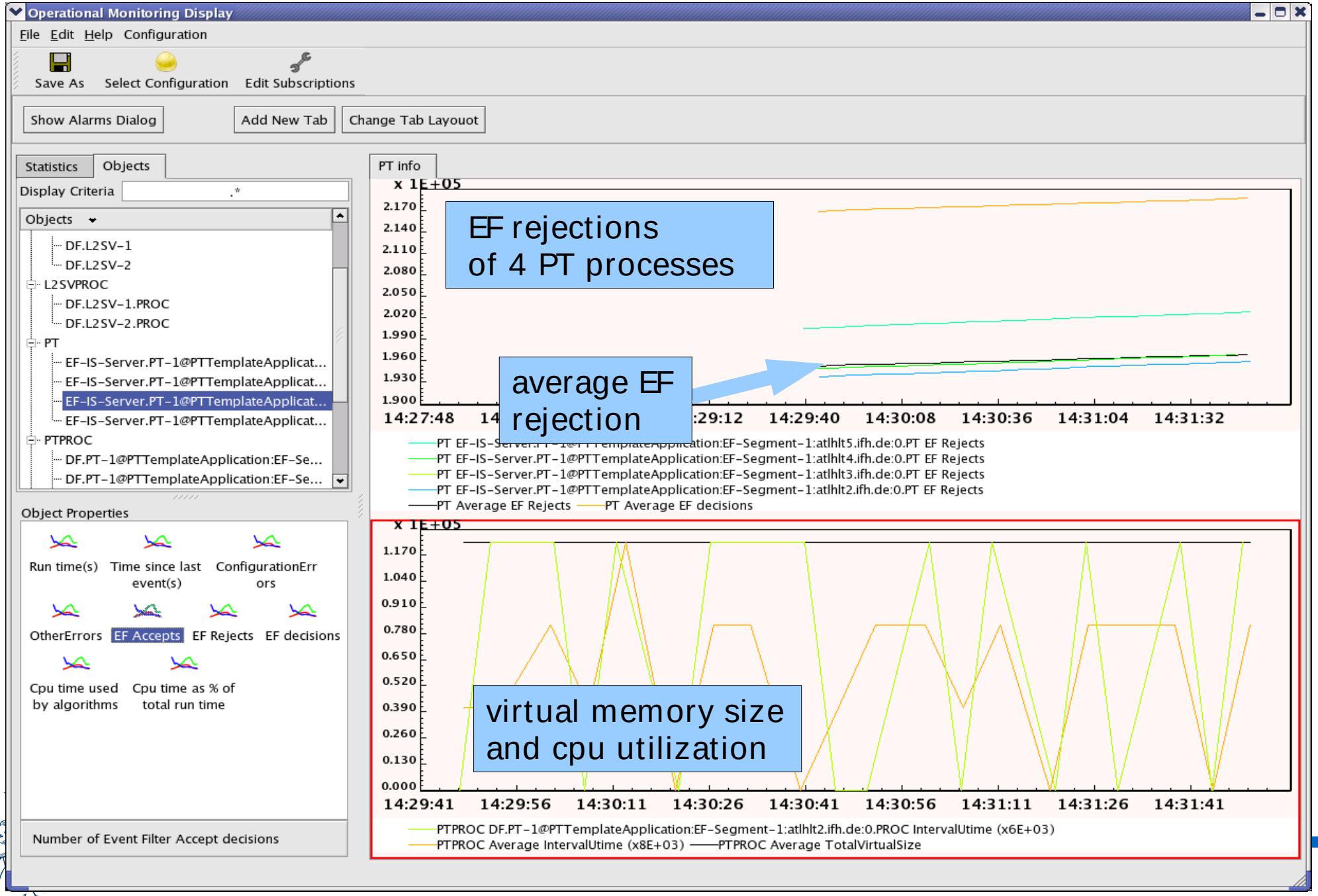
any info available from IS

flexible, generic display:

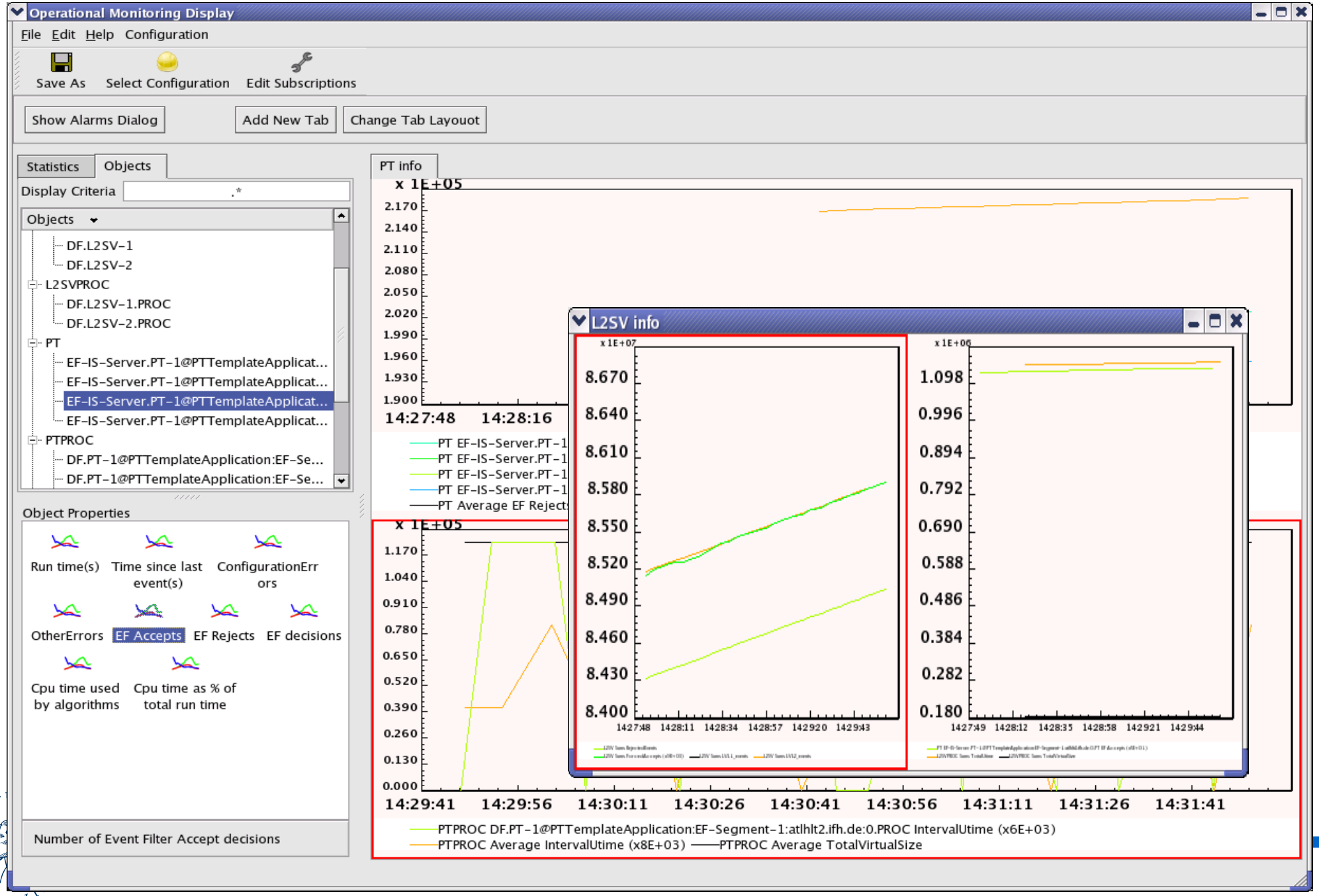
- Σ <> σ f(t)
- configurable for expert or shift

Qt, C++ based, replaces IS logger

Operational Monitoring Display (OMD)

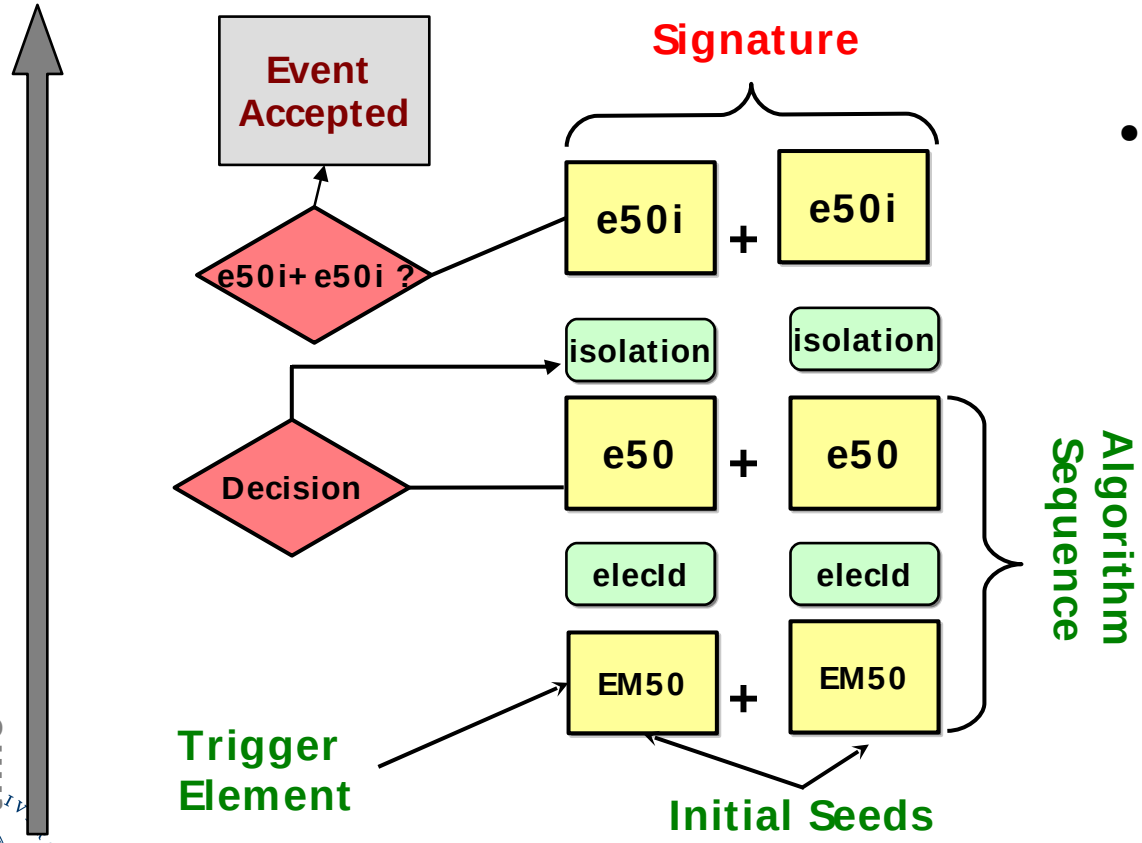


Operational Monitoring Display (OMD)



HLT Trigger Rate Monitoring

- **number of accepted events by each Trigger level**
  rate for each chain, signatures of each chain (stepwise) and individual TE
- part of HLT Steering software running on each farm node (TrigSteerMonitor)
  access to Steering Descision
- produce several 1D and 2D histograms, published to OH



- **grouping of information**:

  rates for combinations of chains:
  trigger slices : Jet- , e/ gamma - , tau, muon- , B- slice etc.
  additional grouping:
  e.g. all chains using a single subdetectors

HLT Trigger Rate Monitoring

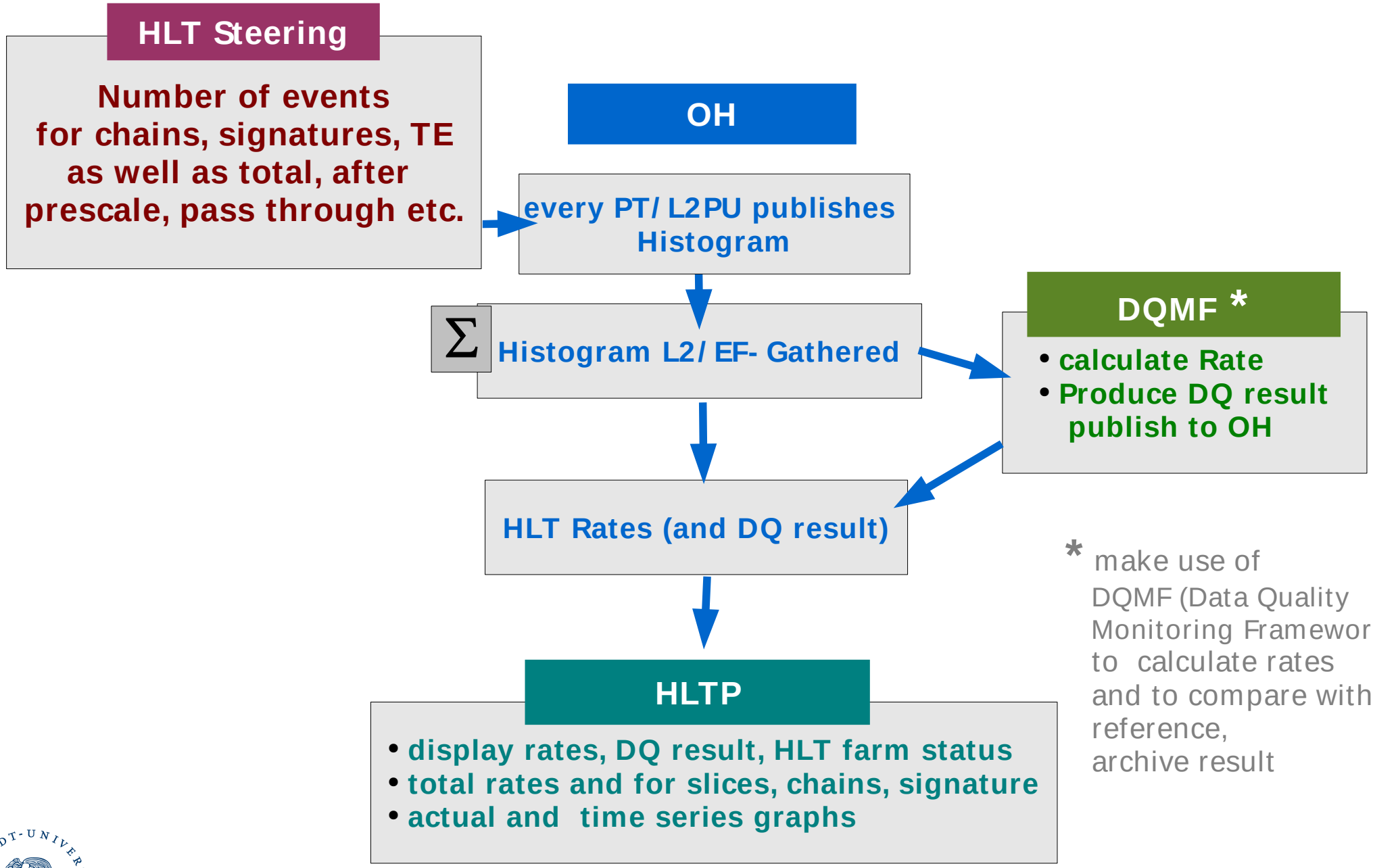
Rate calculation (based on info gathered from all farm nodes)

- **rate averaged over luminosity block** (few minutes):
  well defined t_0 and t_{end} (from LVL1, LHC clock)
  $N / \Delta T$

- **actual rate (averaged over few seconds):**
  problelms:
  which ΔT to use? CPU time on PT, L2PU? Event Time stamp?
  How to combine info from different nodes (diff ΔT) ?

  instead use LVL1 rate :
  acceptance on LVL2 (EF) * LVL1 output rate
  (i.e. N norm. to # input events = LVL1 output)

Trigger Rate Display : HLT Presenter

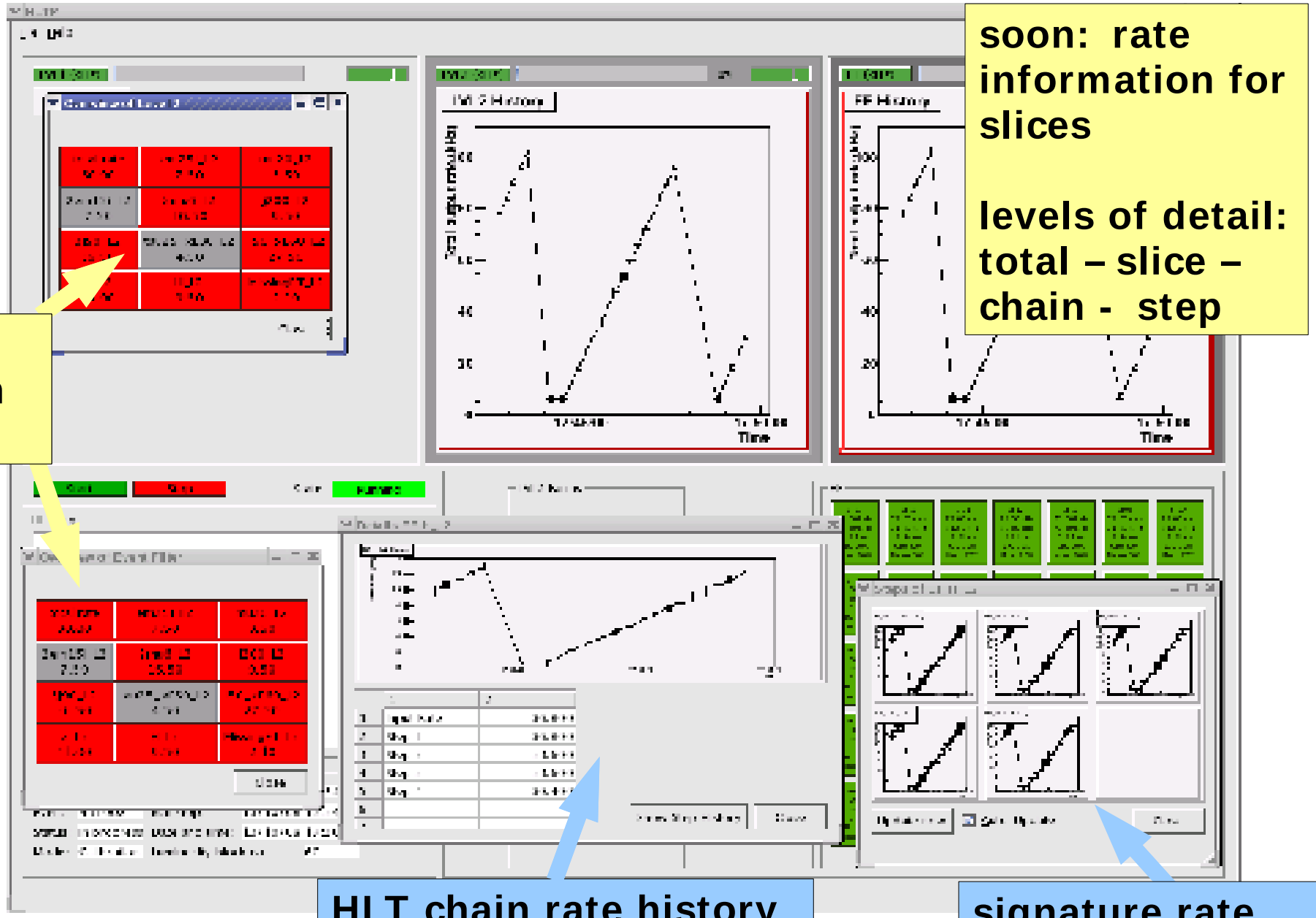


* make use of DQMF (Data Quality Monitoring Framework) to calculate rates and to compare with reference, archive result

Trigger Rate Display : HLT Presenter

Display information on HLT Rates and also LVL1 rates for shift crew

Trigger Rate Display : HLT Presenter



HLT chain rates

soon: rate information for slices

levels of detail: total – slice – chain - step

HLT chain rate history and signature rates

signature rate history

DQ Monitoring on HLT

aim: avoid faulty data taking
- spot problems of HLT or other subdetectors and their sources **online**
- exclude “bad” data from **offline** analysis

2 aspects:
- **HLT as subdetector**
  monitor information sensitive to malfunctions in the HLT event selection
- **DQ using HLT info**
  HLT reconstructed objects, rates sensitive to other subdetectors

DQ Monitoring on HLT

- **Trigger decision and also DQ Monitoring organised in slices**
  e.g. B - , τ–, Jets- , μ–, e/γ – slice
  monitor information e.g. variables used to select events,
  spectra of reconstructed objects, etc.
  examples from muon slice: residuals, phi, x and y
  position of muon, chi2 of tracks, ...
  identify overlap between slices, missing DQ information

- **collect DQ information on a distributed system:**
  each farm node processe single event
  published by HLT algorightms as histos to OH
  DQ histos gathered from all nodes

- **Online DQ assessment :**
  usage of DQMF to analyse histograms and produce DQ result

  tested DQMF checks for many HLT DQ histos in tech. run
  now: need to define test and customise algorithms
  BUT human interaction (especially in startup) indispensable

Outlook

- **OMD and HLTP tested** in technical runs
  :) OMD useful to monitor whats going on
  :) HLTP first tested with info flow
  (HLT Steering, OH, DQMF, HLTP)

- **HLT Rate Monitoring Code**
  well advanced, some functionalities
  missing e.g. slices, exclusive rates

- **DQ HLT Monitoring**
  phone meeting next week – reports from slice representatives on which DQ info is available
  DQMF usage

backup slides

for further discussion ...

Some OMD Use Cases

- If the average CPU utilization of EF or L2PU farms are low it may show that they don't receive events
- If the average or the total virtual memory size of a L2/EF farm is increasing over time it is a sign of memory leak in the algorithms.
- If the average queue size is small but the standard deviation is high this might be a sign of incorrectly distributed workload.

Data Quality Monitoring Framework

- automated **Data Quality tests**
  Offline (HistogramAnalyzer) or **online (DQMF)**
- **Interface to DQ checks** (dqm_core)
  algorithms performed on histograms
  e.g. statistical comparison to reference
  mean, RMS, ...
  any customised algo (e.g. Trigger Rate caluclation)
- **online environment**
  calls algorithm whenever histo published to OH
  perform checks (comparison with reference)

- produces **DQ Result** witht DQ Status flag (bad, medium, good)

- HLTP and DQM on HLT: users of DQMF

https://twiki.cern.ch/twiki/bin/view/Atlas/DataQualityMonitoring

HLT DQ Monitoring using DQMF techrun May

Technical run: DQ checks on HLT histograms

- **many histos checked with `Histogram_Not_Empty` (~100 hundred)**

- **compare RMS, Mean to thresholds for some other histos using `CheckHisto_Mean` `CheckHisto_RMS`**
  - muon slice: residuals, phi, x and y position of muon, chi2 of tracks, ...
  - tau slice: hit distributions
  - E/gamma: Jet Energy on EF and LVL2

- **also tried comparison to references (bin-by-bin, Chi2Test) for some histos**

Online DQ tests should be robust

Compare histo with reference : mean and variance of distributions

alternative: use **robust moments**

suggestion by
Thomas Naumann

distributions are not normal,
but maybe skewed,
have outliers or tails

e.g.

weights $w_i = \exp[-(x_i - \langle x \rangle)^2 / \sigma^2]$

and use $\sum w_i x_i / \sum w_i$ instead of $\langle x \rangle$

and $\sum w_i x_i^2 / \sum w_i$ instead of σ^2

for online checking these (or other robust moments)
might turn out to be helpful

more investigations and experience on how to best compare
online histos needed ...