Trigger Monitoring at ATLAS

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on behalf of the ATLAS TDAQ Collaboration

ICATPP09
Como

Outline:

The ATLAS Trigger system and DAQ

The Online Monitoring Framework

First experience with real data

The ATLAS Trigger System

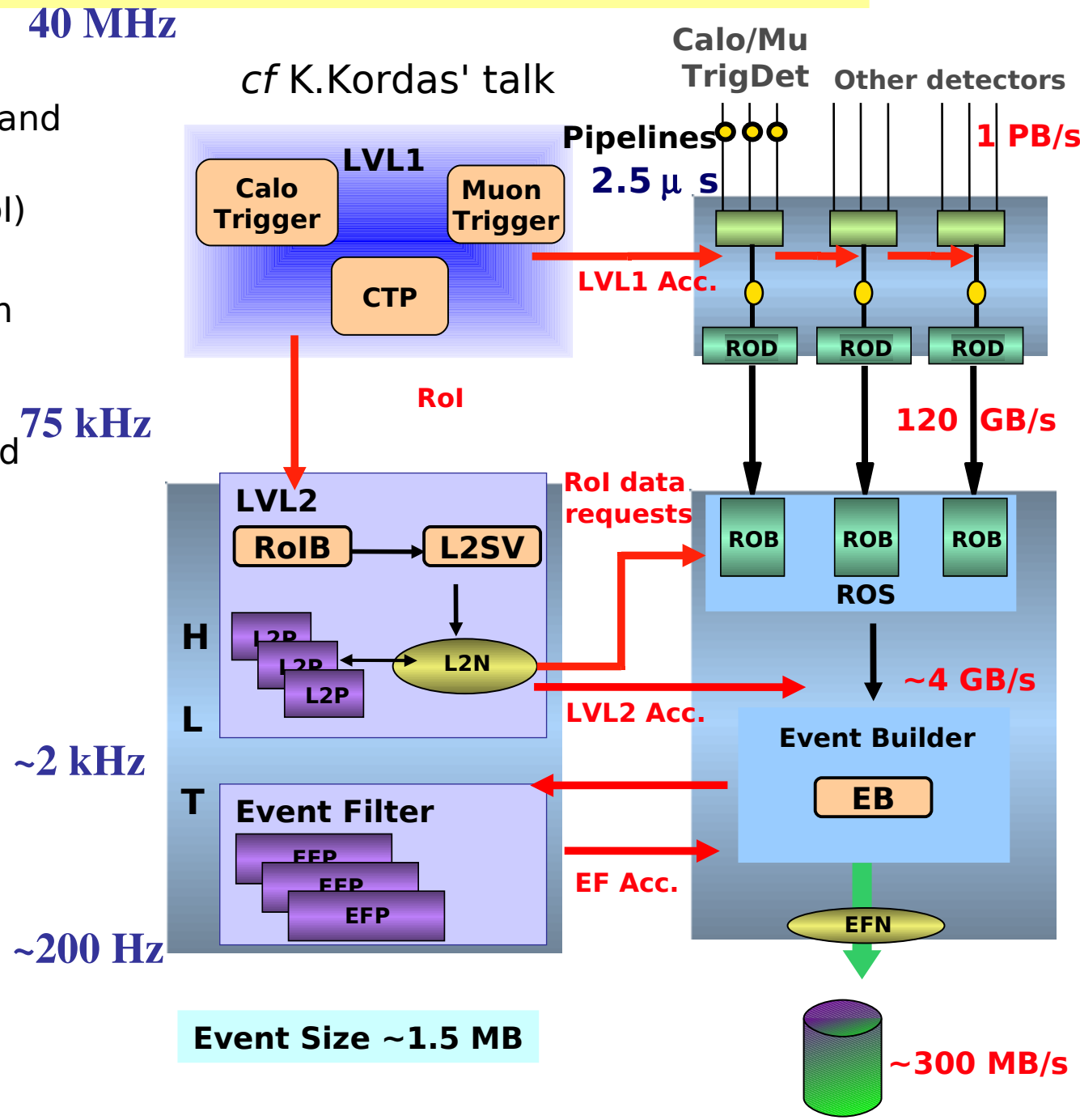
Level 1
- Hardware based
- Coarse granularity calorimeter and muons
- Identifies Region of Interest (RoI)

High Level Trigger (HLT)
- Level 2 and Event Filter PC farm
- Algorithms reconstruct physical quantities
- Monitored physics reconstructed variables
- Trigger chains organized in "physics slices"

Level 2 (L2)
- Full detector granularity in RoIs
- Special fast algorithms

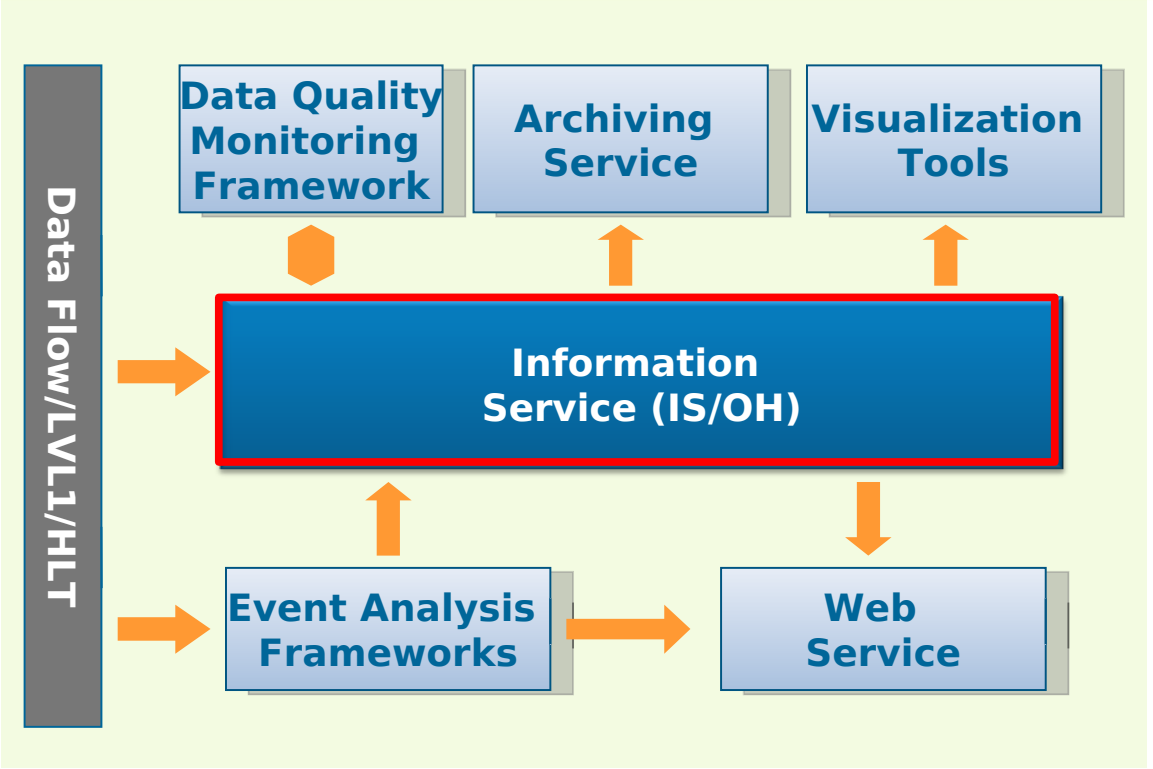
Event Filter (EF)
- Full event available
- Full detector granularity
- Offline-quality algorithms

In 2009:
27 Racks for L2 and EF
~800 nodes (8 cores/node)
1/3 of full system



Highly Distributed System

Online Monitoring Framework



Monitoring during TDAQ Commissioning (now and first weeks of collisions)

Increase data taking efficiency

prevent/understand conditions that stop data taking

Maximize: ATLAS Recording time/LHC beam time

Increase physics efficiency

Recorded data good for physics?

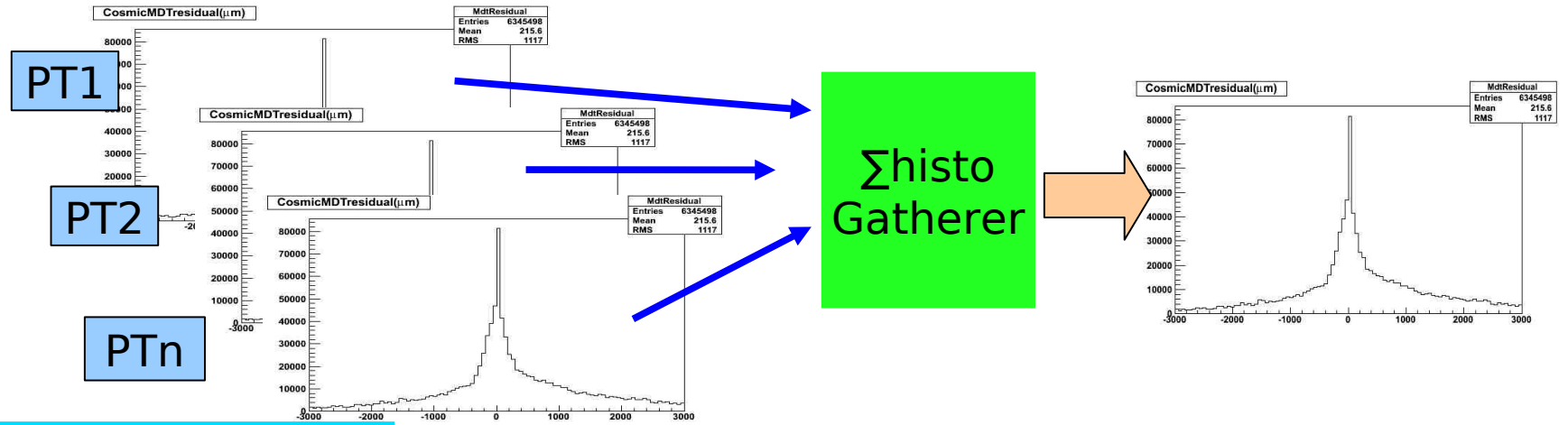
Maximize: ATLAS events good for physics/ATLAS recorded events

Display, Monitor and Analyze:

- Operational Data from TDAQ components
- Event content and histograms produced

Gathering the histograms

Sums all the histogram produced by HLT farms



PT: Processing Task

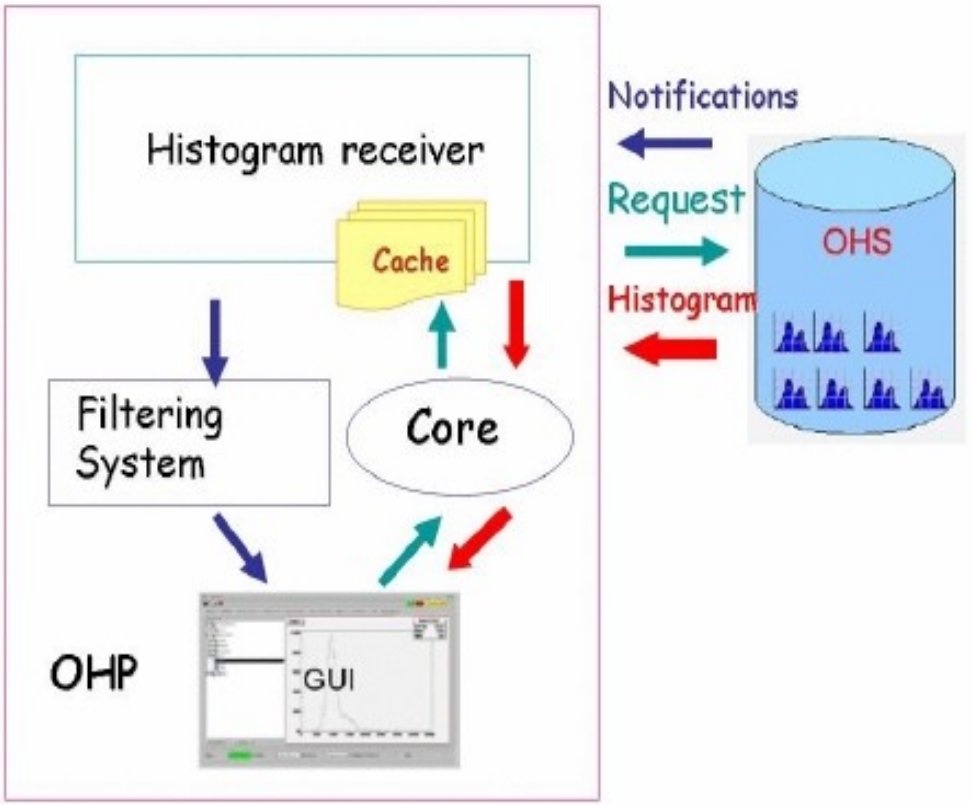
A single application → 2500 histograms (now, will probably increase)
A single HLT rack : 250 applications
Total number of histos *per* rack: 600k
23 HLT racks in 2009 (1/3 of final size)

- Need gatherer optimization (CPU, Memory, bandwidth)

Graphical Applications

Online Histogram Presenter:
Interactive presenter displaying histograms stored in IS/OH:

- Large number of histograms to display
- Possible to interact with histograms (zoom, fit, log/lin scale, etc...)
- Minimize network traffic via a subscription mechanism: process is informed when the histogram is published or updated
- Sophisticated cache mechanism
- Manage reference histograms
- Configurable with XML



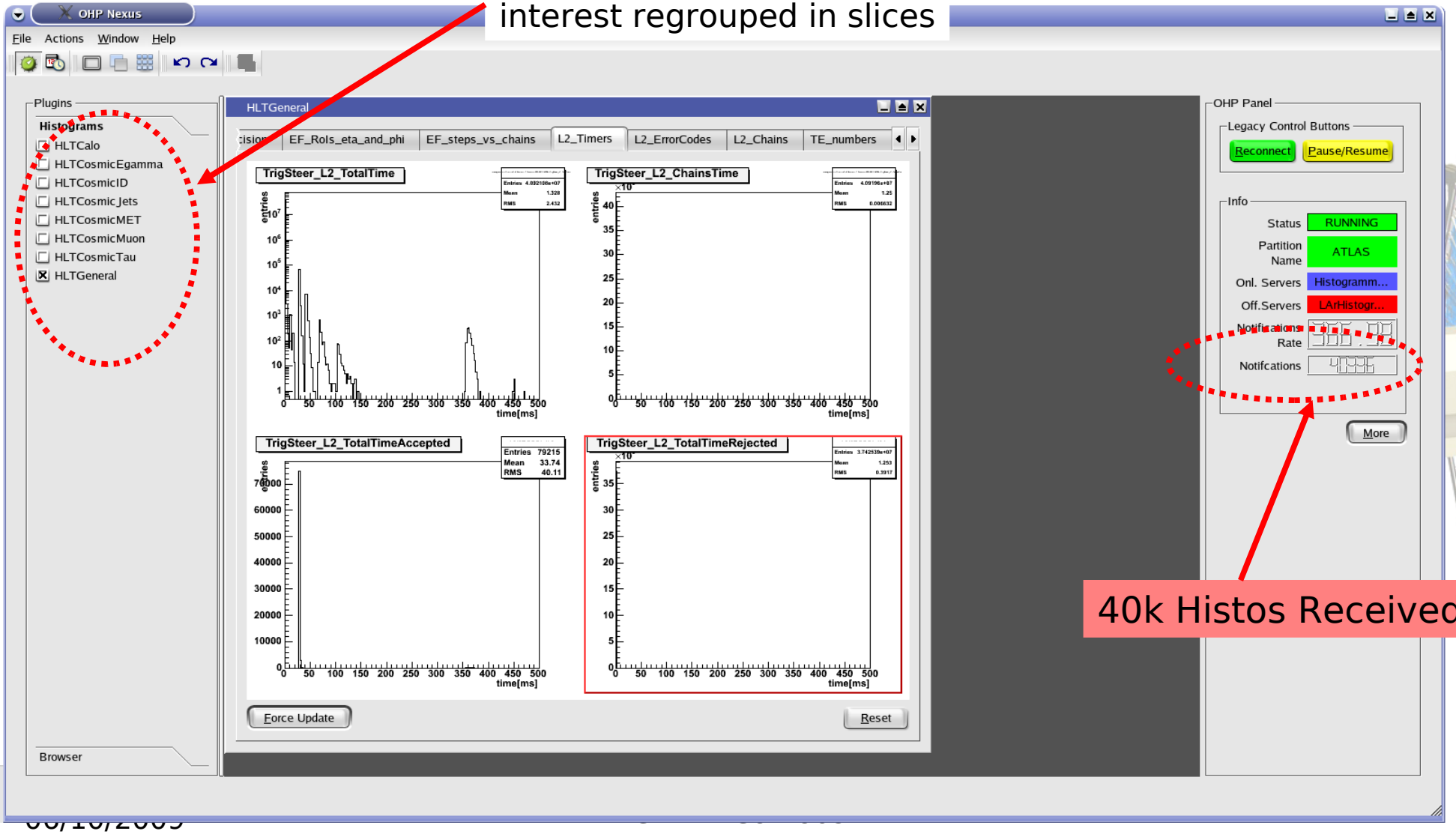
"visual check" by Atlas Control Room shifters (main shifter tool)
Histograms are organized in *Physical Slices* (electron/gamma, muon, jets,...)

OHP

- Supports hierarchy of tabs which contains predefined set of histograms
- Reference histograms can be displayed as well
- Sub-systems have several tabs with most important histos which have to be watched

Shifter Oriented Tool

Trigger chains of common interest regrouped in slices

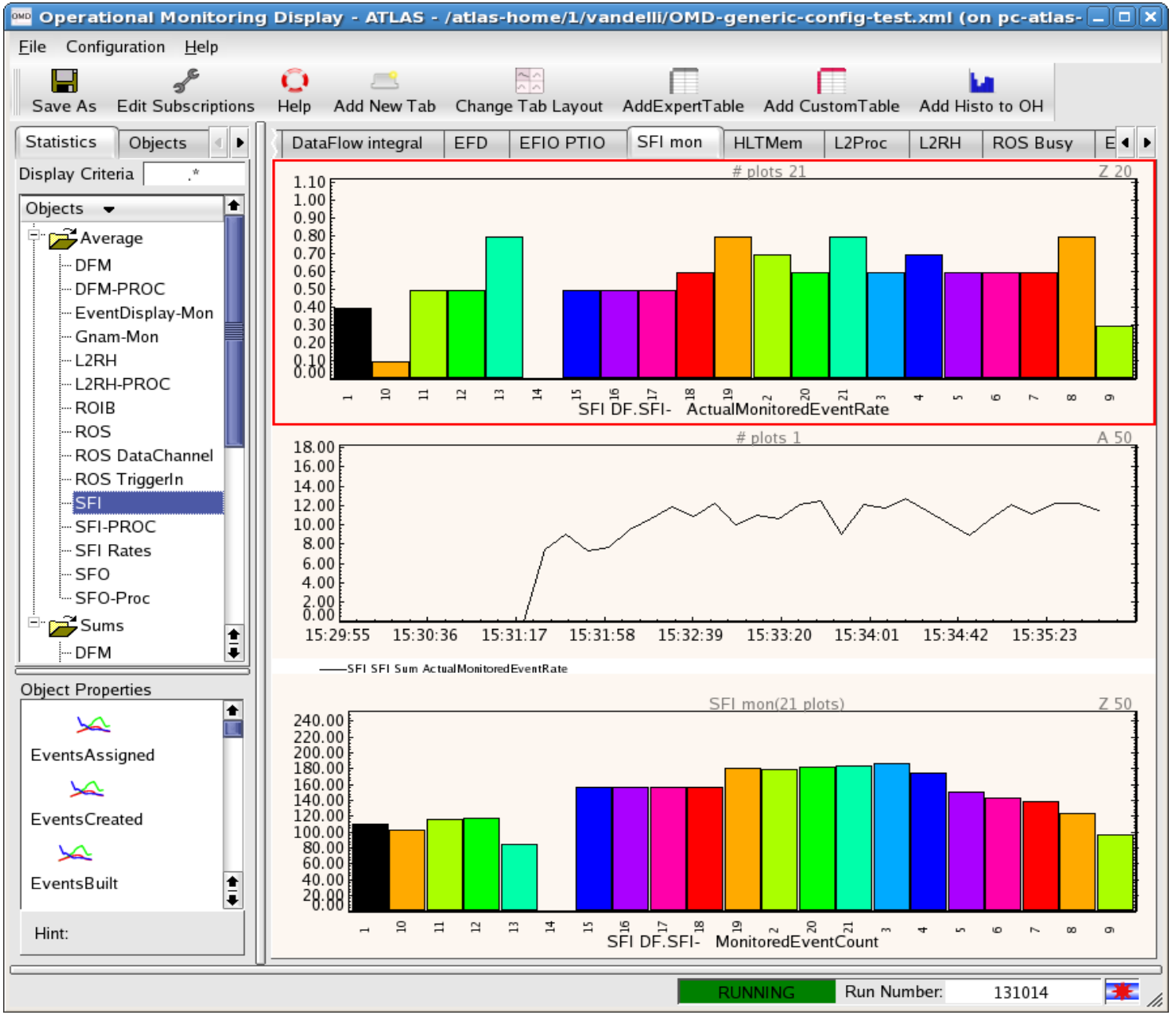


40k Histos Received

Operational Monitoring Display

- Displays quantities in IS in time series, bar charts, tables or distributions
- Calculate basic statistics (sum, thresholds, averages, ...)
- Publishes back in OHP
- Configurable via *Drag'n Drop* approach
  → RunTime
- Mostly used to monitor L2 and EF farms

Two possibile display levels:
Expert and User



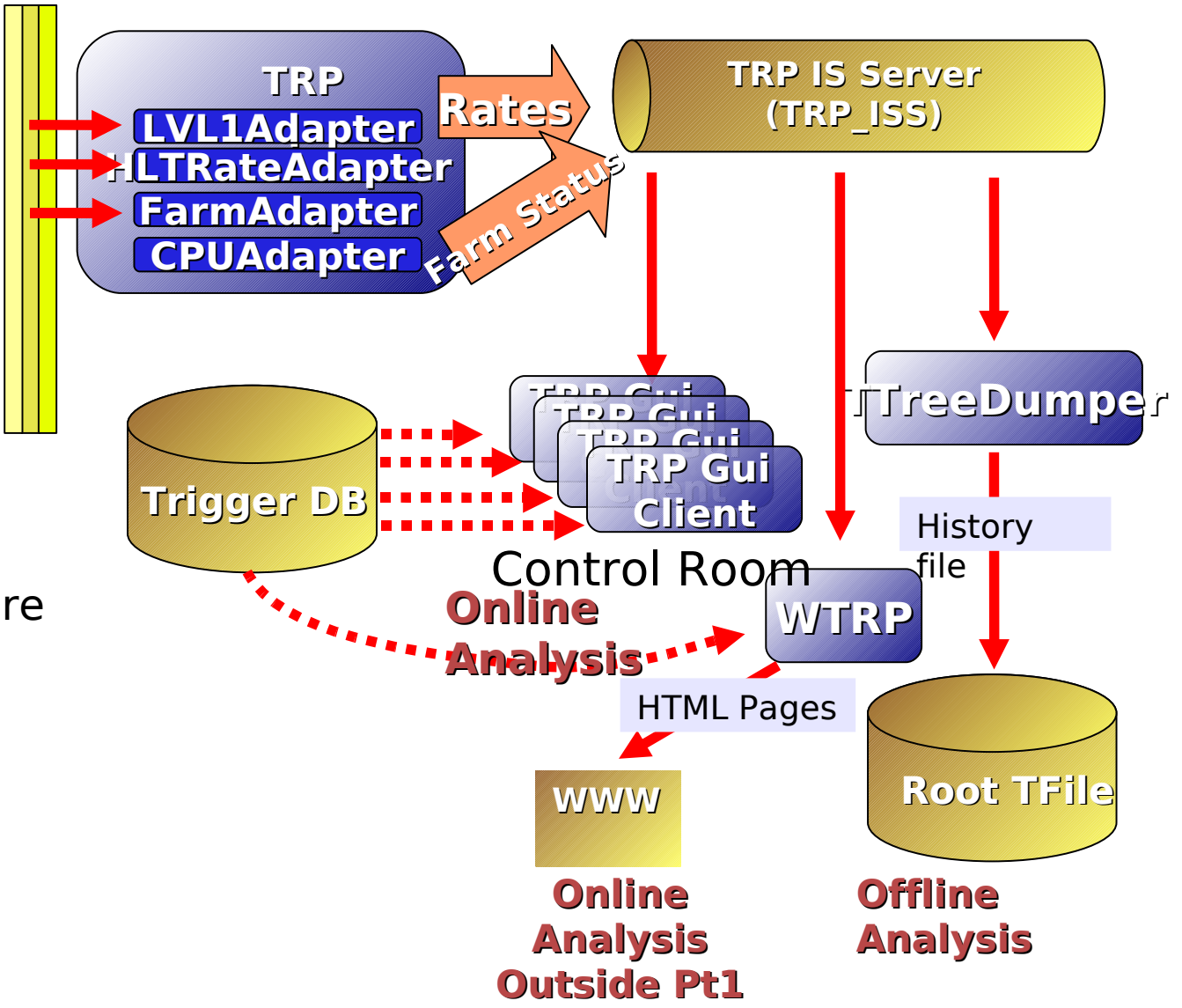
Trigger Rates

Trigger Rates: one of the most useful quantities to monitor.
Sudden increase/decrease → Variation in ATLAS detector (TDAQ)

Trigger Rate Presenter:
A package that calculates, displays, archives and publishes the trigger rates

Main driving ideas:
- Client-Server architecture
→ Modularity
→ Scalability

Shifter user-oriented

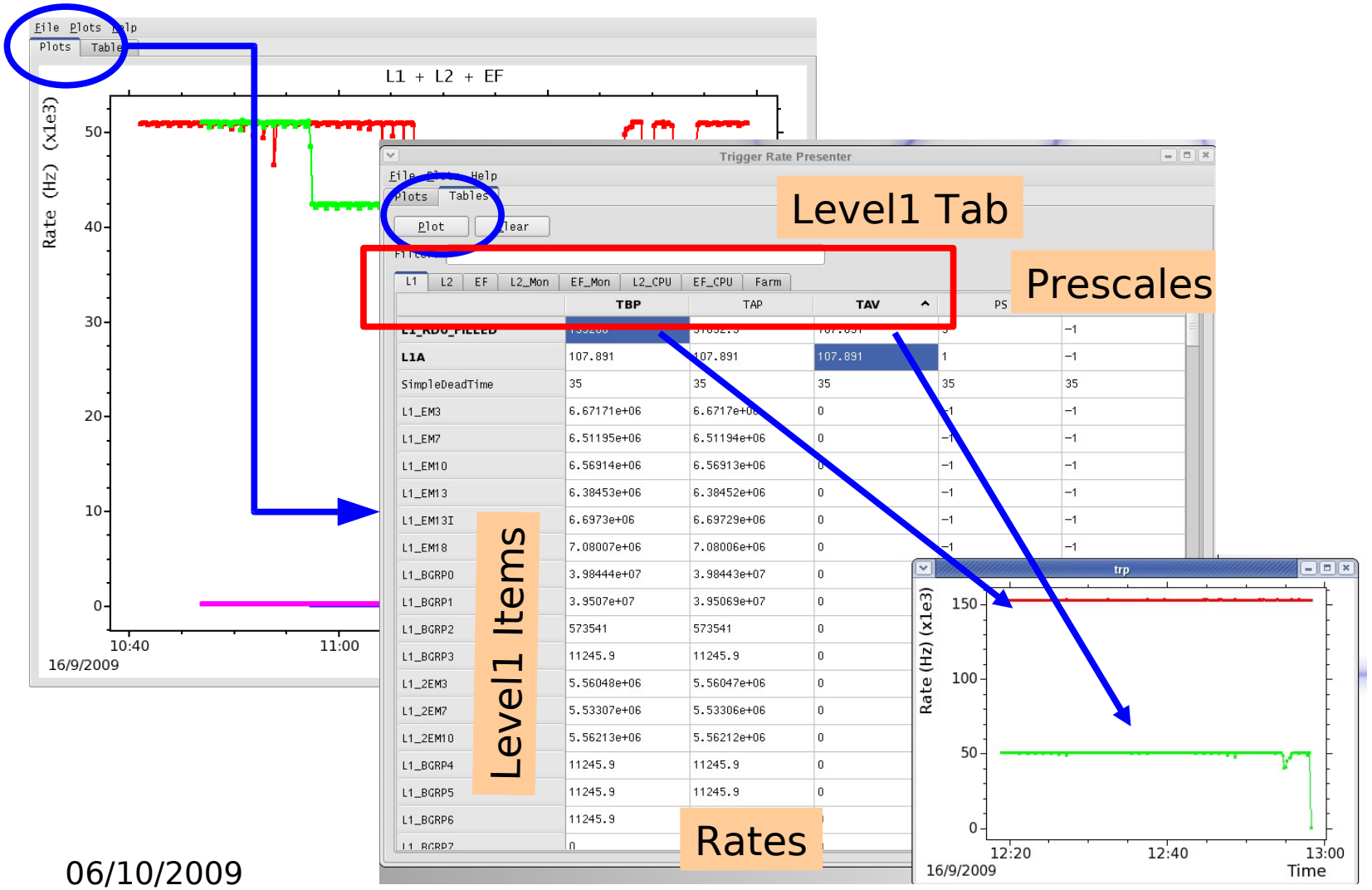


Trigger Rate Presenter

Servers perform CPU intensive rate calculation

Clients:

- GUI showing timetrends and values in tables
- Archiver tool (in Root file)
- Web factory for html pages

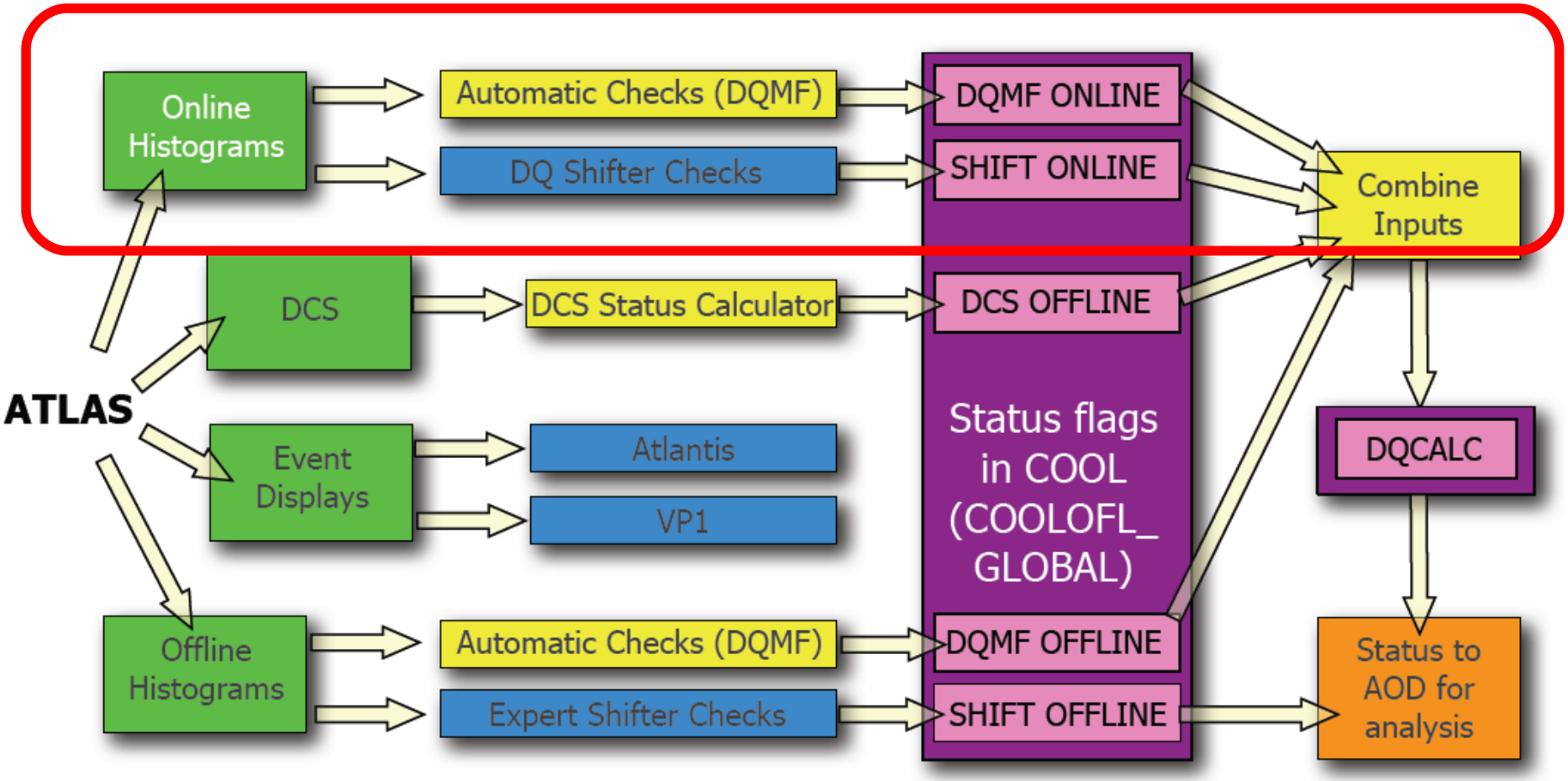


Data Quality Monitoring Framework

Automatic checks on produced histograms
Many predefined algorithms for checks (*e.g.* non empty histograms, mean and RMS values, fitted parameters, KS test wrt reference histograms)
→ Also user defined checks

Output: A Data Quality flag:

- available in realtime to the shifter
- recorded in the Conditions DB



Data Quality Display

- General ATLAS tool → Trigger specific “tab”
- Results of checks build Data Quality Flags for Trigger
  - One flag per Trigger slice

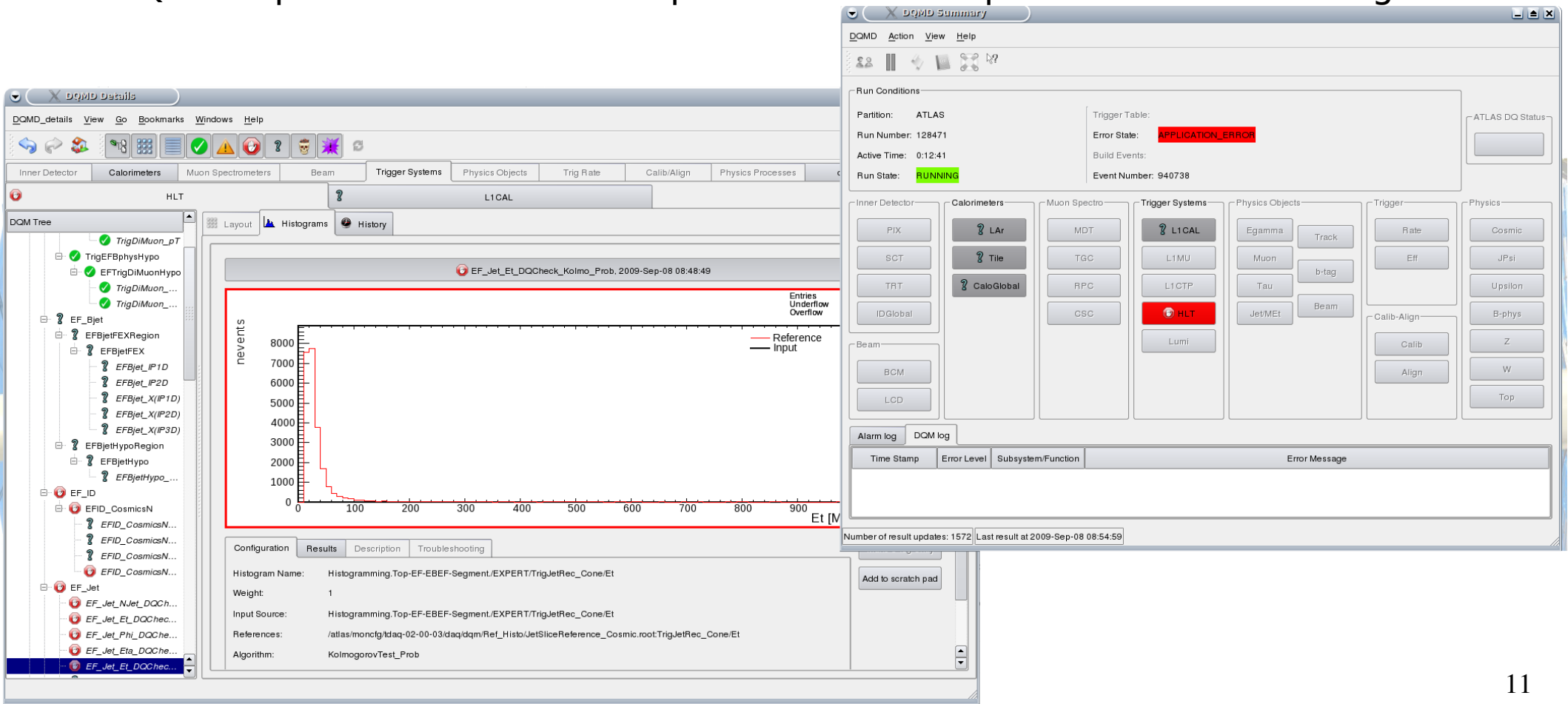
Configuration based on XML files

Different configuration for different Run conditions (Cosmics, Beam, Single Beam, Early Beam)

- Color code indicates the status of each slice:

ok, warning, bad, undefined, disabled

DQMF duplicated in Tier0 and specific farms for quick offline monitoring



ATLAS Remote Monitoring

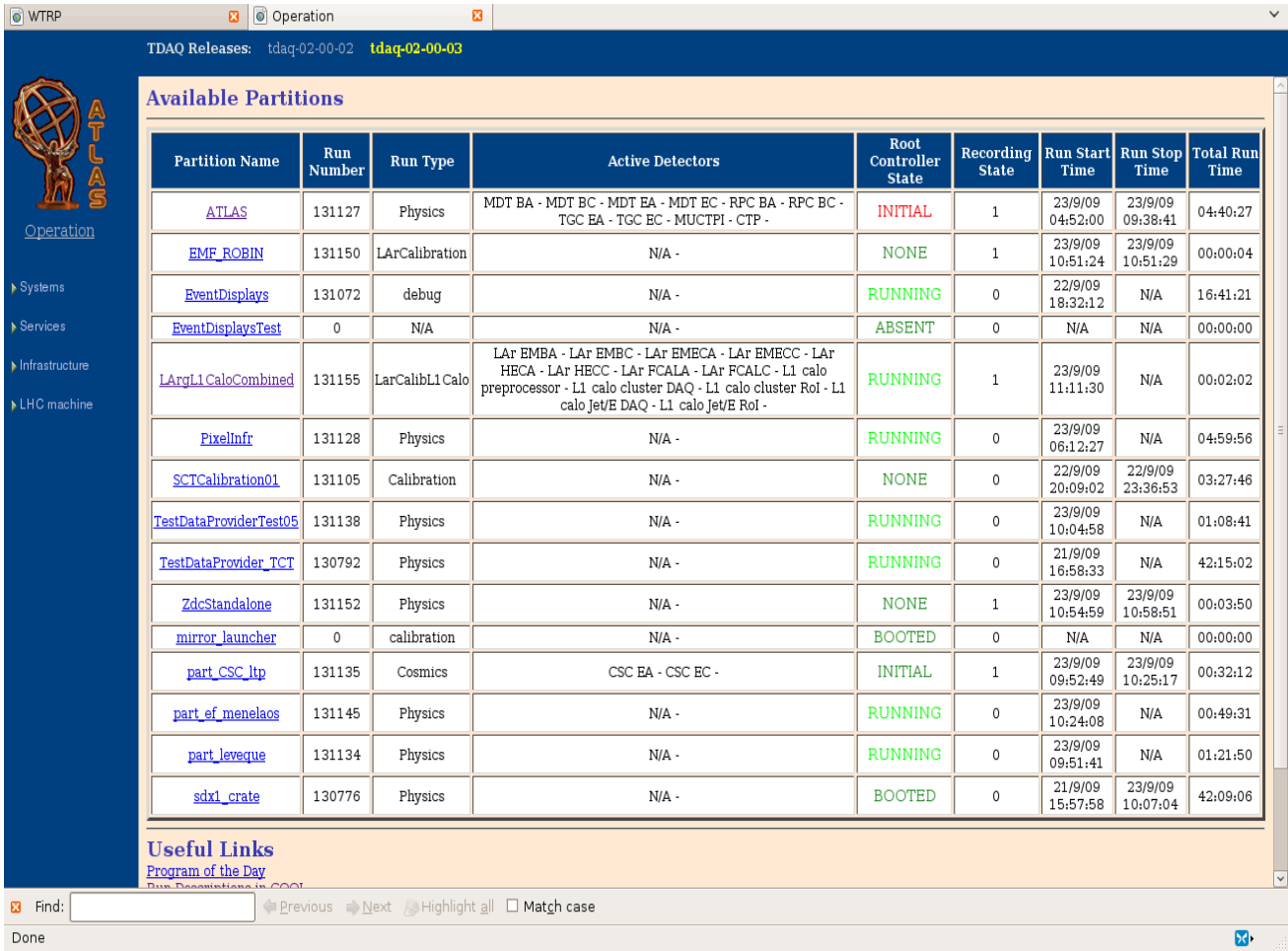
RM User	RM Technology
Public community	Web Monitoring Interface
Remote shifters	Copy monitoring data in quasi real-time mode from ATLAS network to dedicated machines in CERN GPN ATLAS_Mirror Partition
Remote experts	Secure log-in by request of Shift Leader

Web Monitoring Interface

- Periodically generates HTML pages with monitoring information.
  - Information shown is fixed and coded in the plugin

  → non-expert oriented tool

- 3 plug-ins are currently used at P1:
    - Run Status
    - Data Quality
    - Trigger Rates (from TRP)
  - Referenced from the ATLAS Operation page:
    - http://pcatdwww.cern.ch/atlas-point1/opera.php



Global rates, Stream fractions, Group fractions, L1 rates, CPU usage, L1raw, L2raw, EFraw, WTRP status

Links to other pages (same on all pages)

Total rates

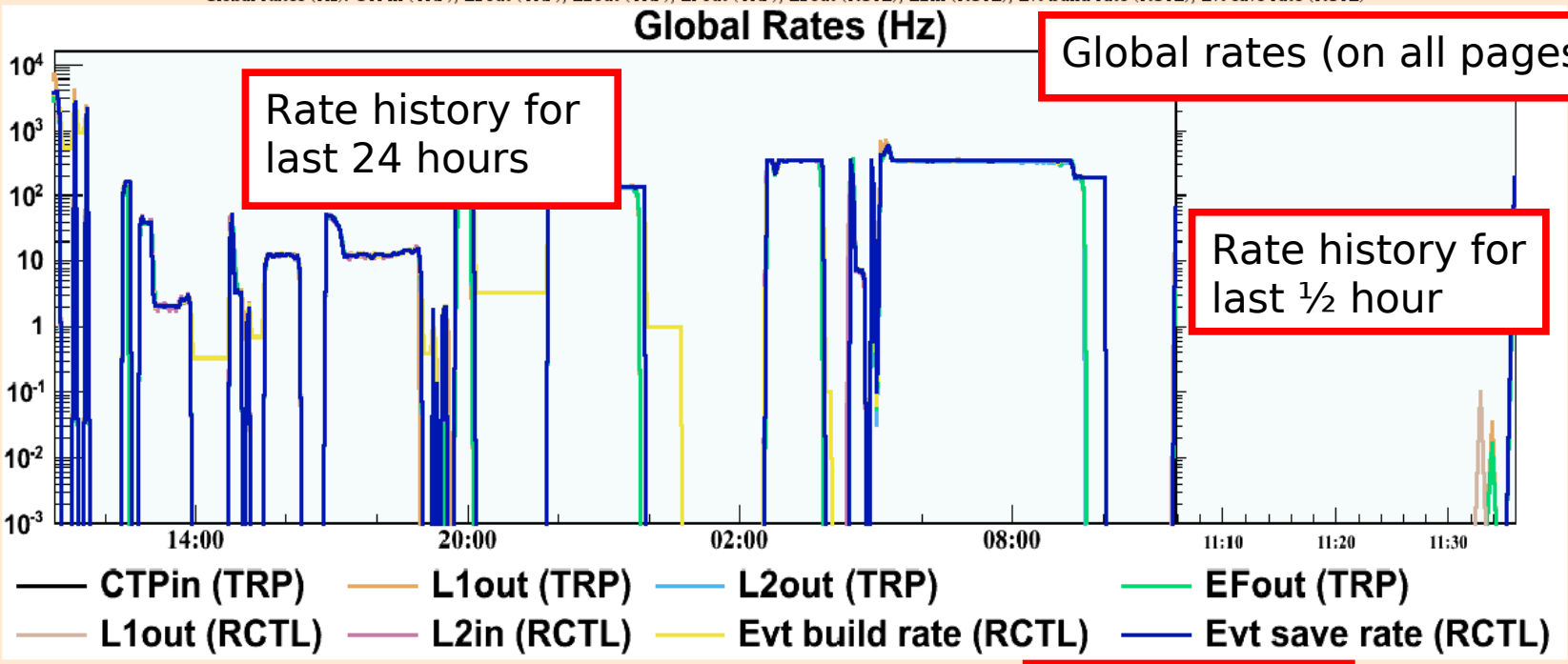
Latest time stamps -- L1: 23/9/09 11:35:39.116567, L2: 23/9/09 11:35:40, EF: 23/9/09 11:35:40

Time stamps of latest TRP update (all pages)

Global rates (Hz)

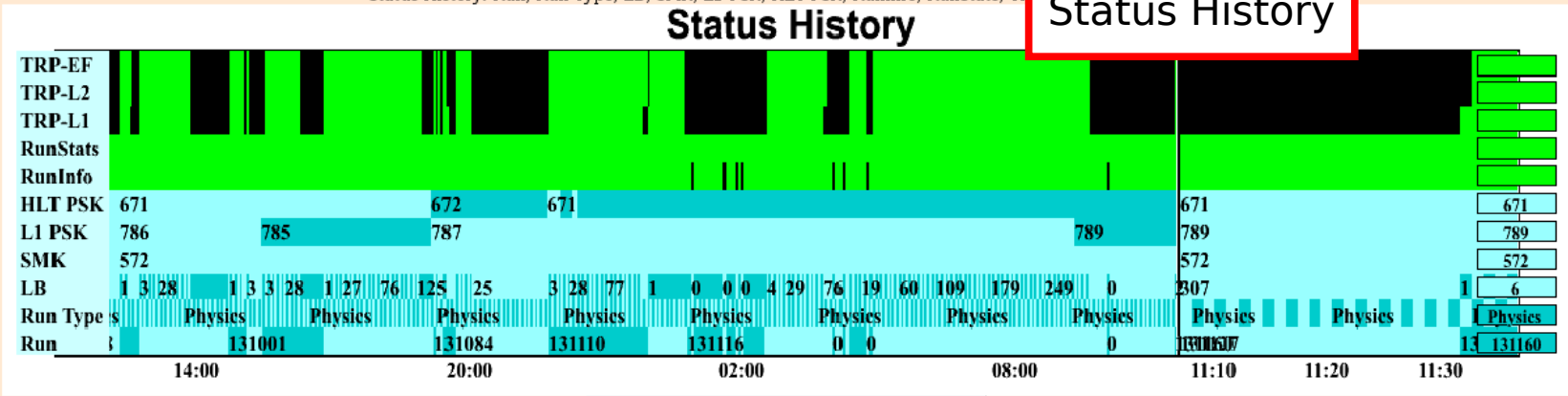
Source	CTP In	L2 In	EF In	EF Out
TRP	7.18e+01	3.21e+01	3.37e+01	3.37e+01
RCTL	--	1.75e+02	1.95e+02	1.95e+02

Global Rates (Hz): CTPin (TRP), L1out (TRP), L2out (TRP), EFout (TRP), L1out (RCTL), L2in (RCTL), Evt build rate (RCTL), Evt save rate (RCTL)



Global rates (on all pages)

Status History: Run, Run Type, LB, SMK, L1 PSK, HLT PSK, RunInfo, RunStats, TR

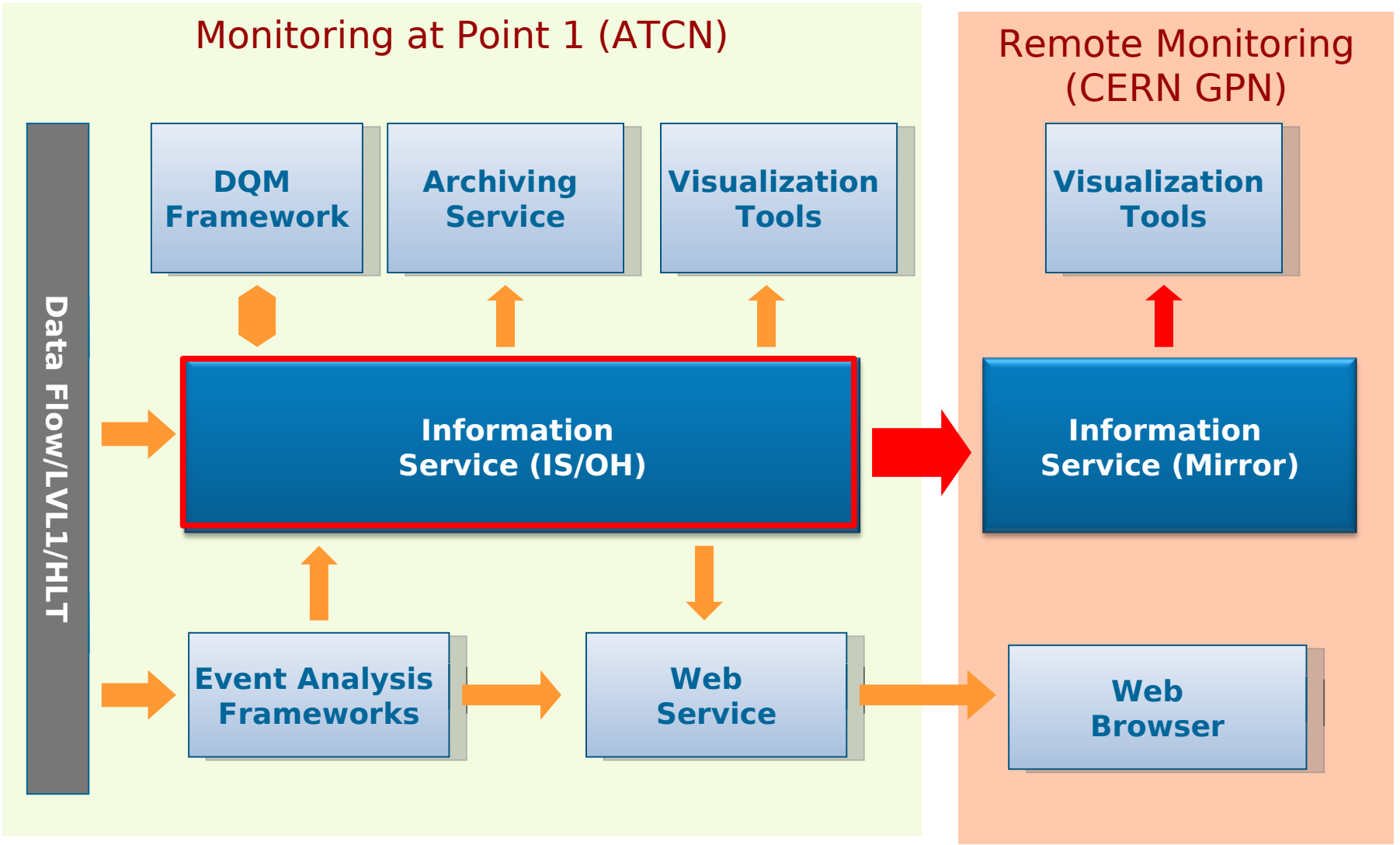


Status History

Entry	Time	Parameter	Changed to
320	22/9/09 11:38:18	Run Type	Physics
321	22/9/09 11:40:21	Run Type	Physics

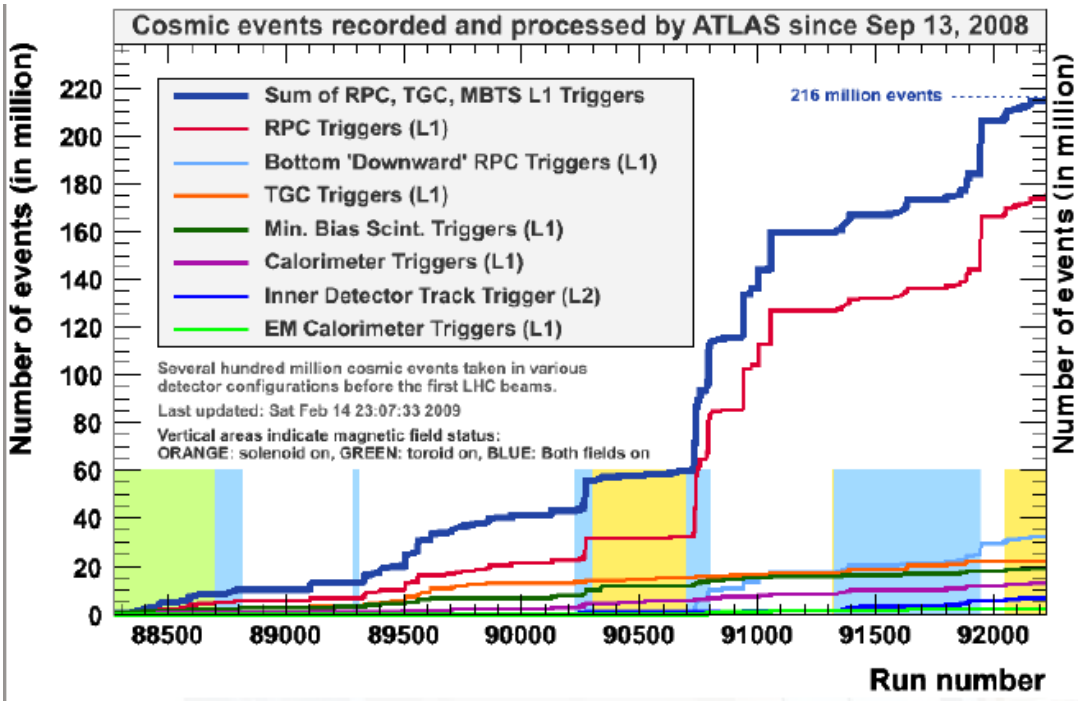
Log

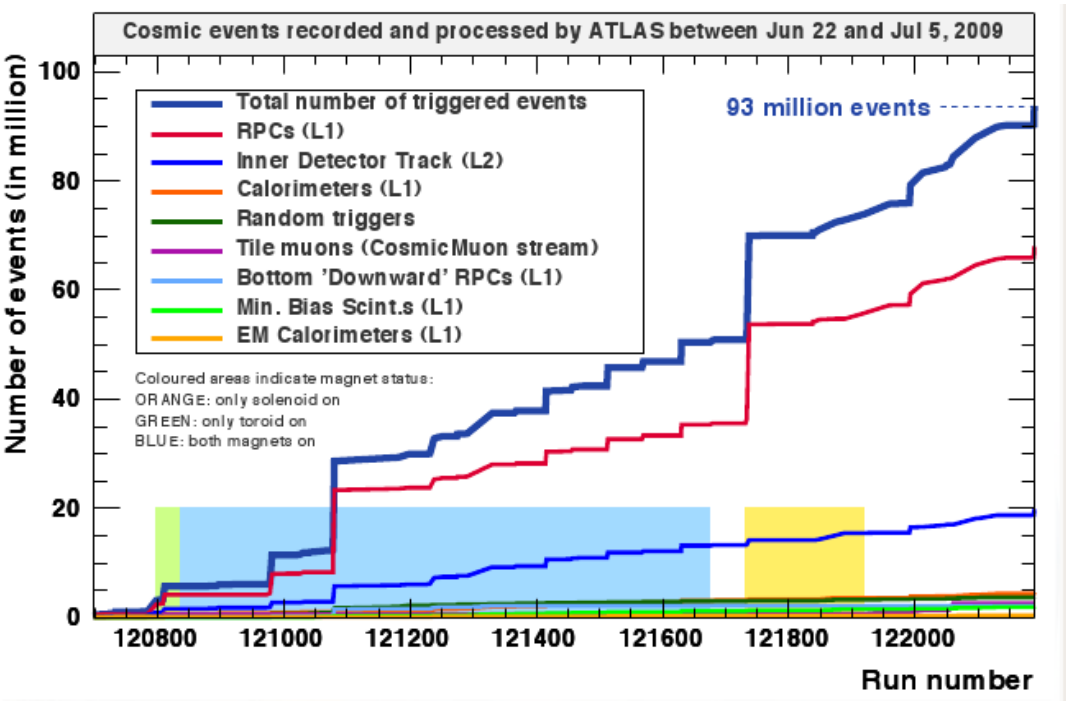
Remote Monitoring Partition



Mirror partition replicates outside closed network most important data.
Monitoring tools read the “mirrorred” partition outside ATLAS

Performances with early data





ATLAS recorded real cosmics data in 2008 and 2009 (cf talk xyz)
TDAQ system in commissioning phase → Need a working Trigger Monitoring

- More than 150 event monitoring tasks *per* run
- 4 millions histogram updates *per* minute
- 100k histograms saved at the end of run

Will probably increase by a factor 3 with final system

Conclusions

- Online Monitoring Infrastructure for Trigger is deployed and works reasonably well.

Many tools for the trigger shifter are available

→ Trigger monitoring information is well covered

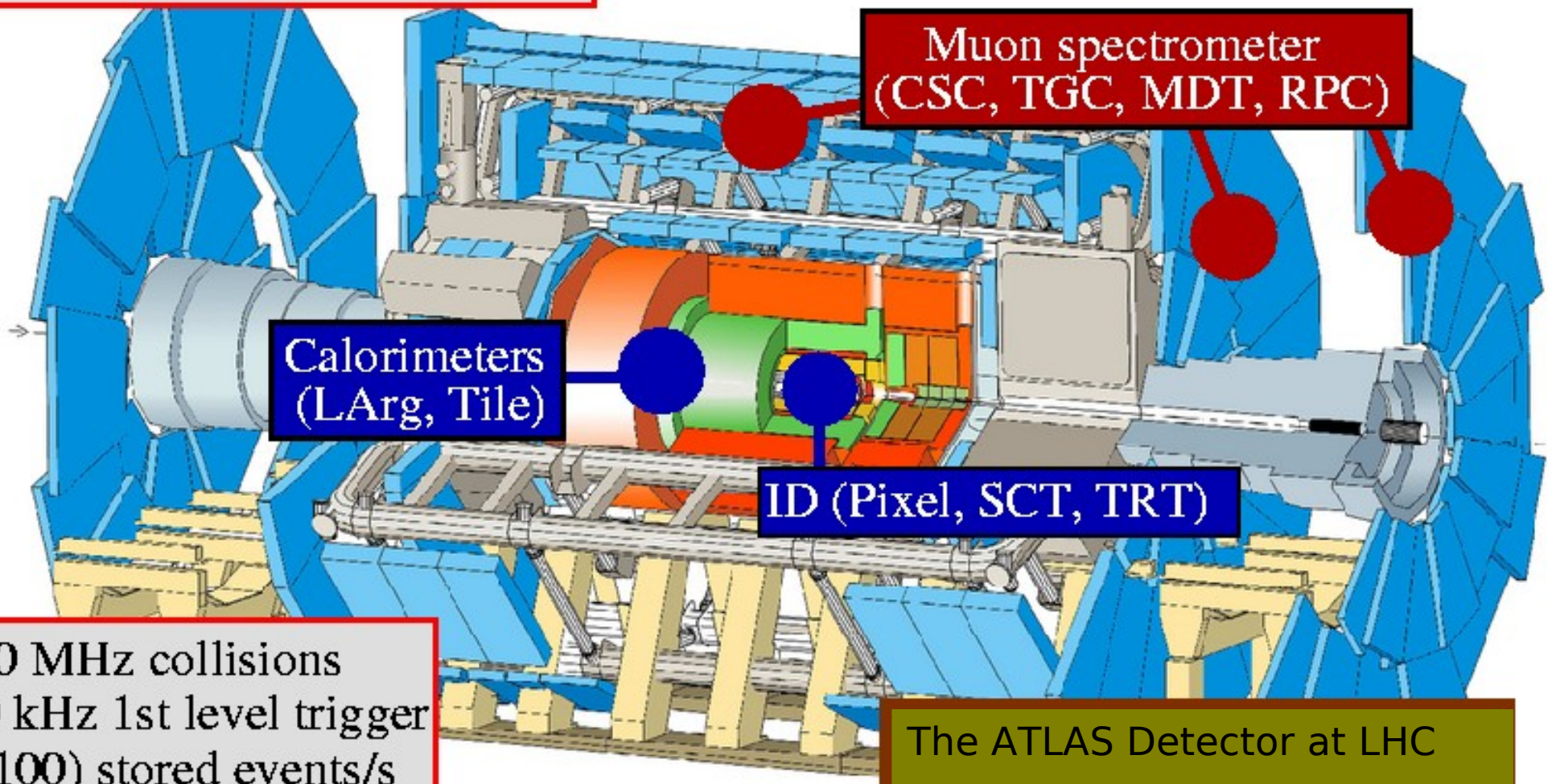
Further experience with real (collisions) data:

- Tuning of some part of ths system (e.g. reference histograms for DQM)
- Optimize the interaction Shifter  Trigger Monitoring tools

BackUp

Being assembled around
Large Hadron Collider @ CERN
p−p collisions with $\sqrt{s}$ = 14 TeV

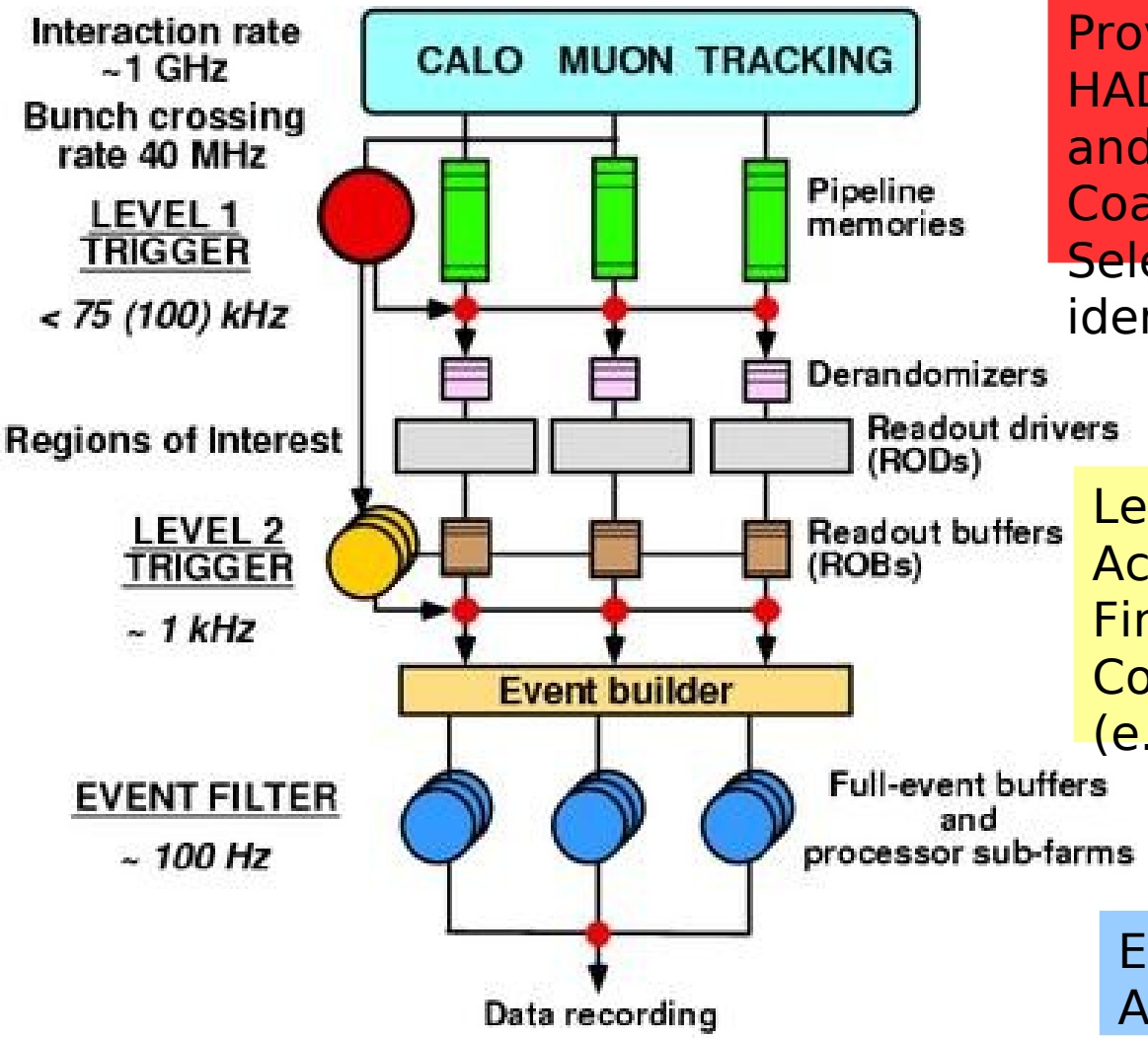
44 m long, 22 m high, 7000 tons
140 Mchannels, 1 MB/event



40 MHz collisions
100 kHz 1st level trigger
O(100) stored events/s

The ATLAS Detector at LHC

The ATLAS Trigger System

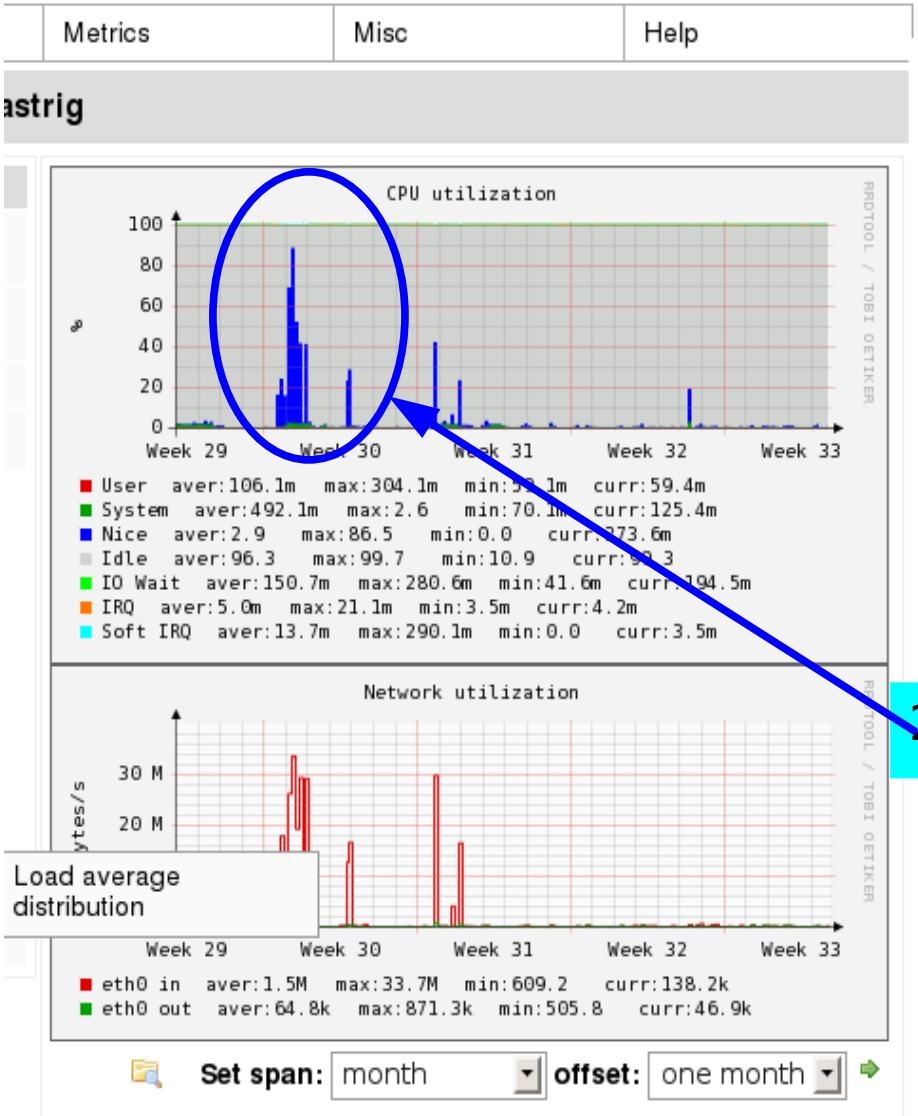


Level-1Trigger:
Provided by Calorimeters (EM and HAD) and Muon Spectrometer (RPC and TGC).
Coarse grained granularity.
Selects Regions of Interests (RoI) and identifies Bunch Crossing (BC)

Level-2 Trigger:
Access data in selected RoI.
Fine grained granularity.
Combination with other subdetectors, (e.g. ID Tracker)

Event Filter:
Access full event with full granularity

Offline Trigger Monitoring-CAF



CAF is a pool of reserved (ATLAS trigger) PCs (8 multicore) in the lxbatch system
Access to several castor pools with dedicated disk servers (also RAW data)
Run users' jobs.

2 weeks of cosmics data taking June-July

As soon as data will start to flow → less idle time on CAF

Offline Trigger Monitoring-CAF

Different usages:

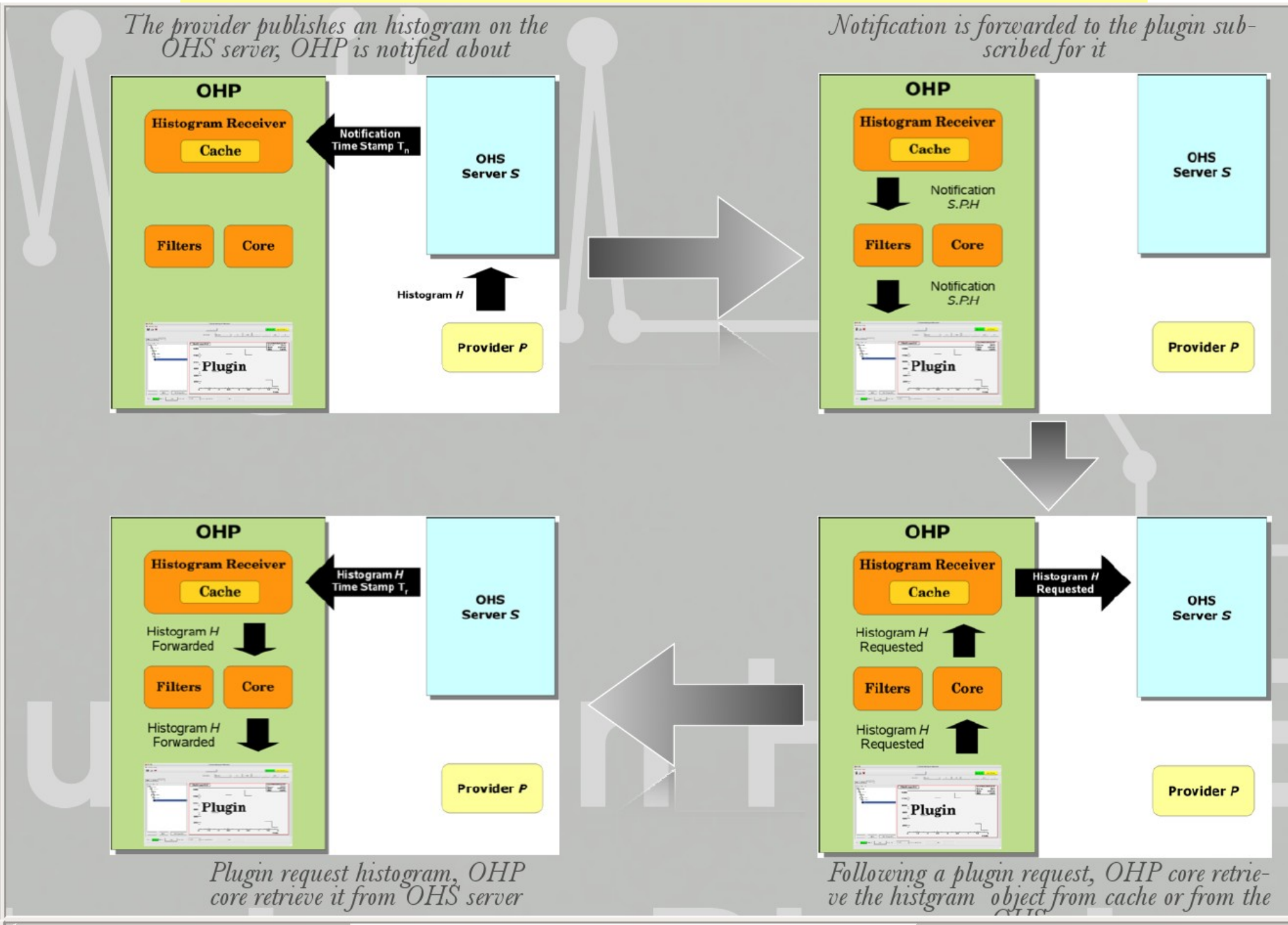
- Run HLT Trigger on Level-1 selected data (in particular express stream)
  - → Test new trigger keys before online deployment
  - Classify HLT errors (Run on Debug stream)
  - Run Trigger offline monitoring on RAW data
  - Rerun the trigger selection on the CAF
  - Produce “trigger ntuple”
  - Estimate trigger rates for new trigger menus (occasional and lower priority)

Ideal place to rerun the Trigger reconstruction on selected events.

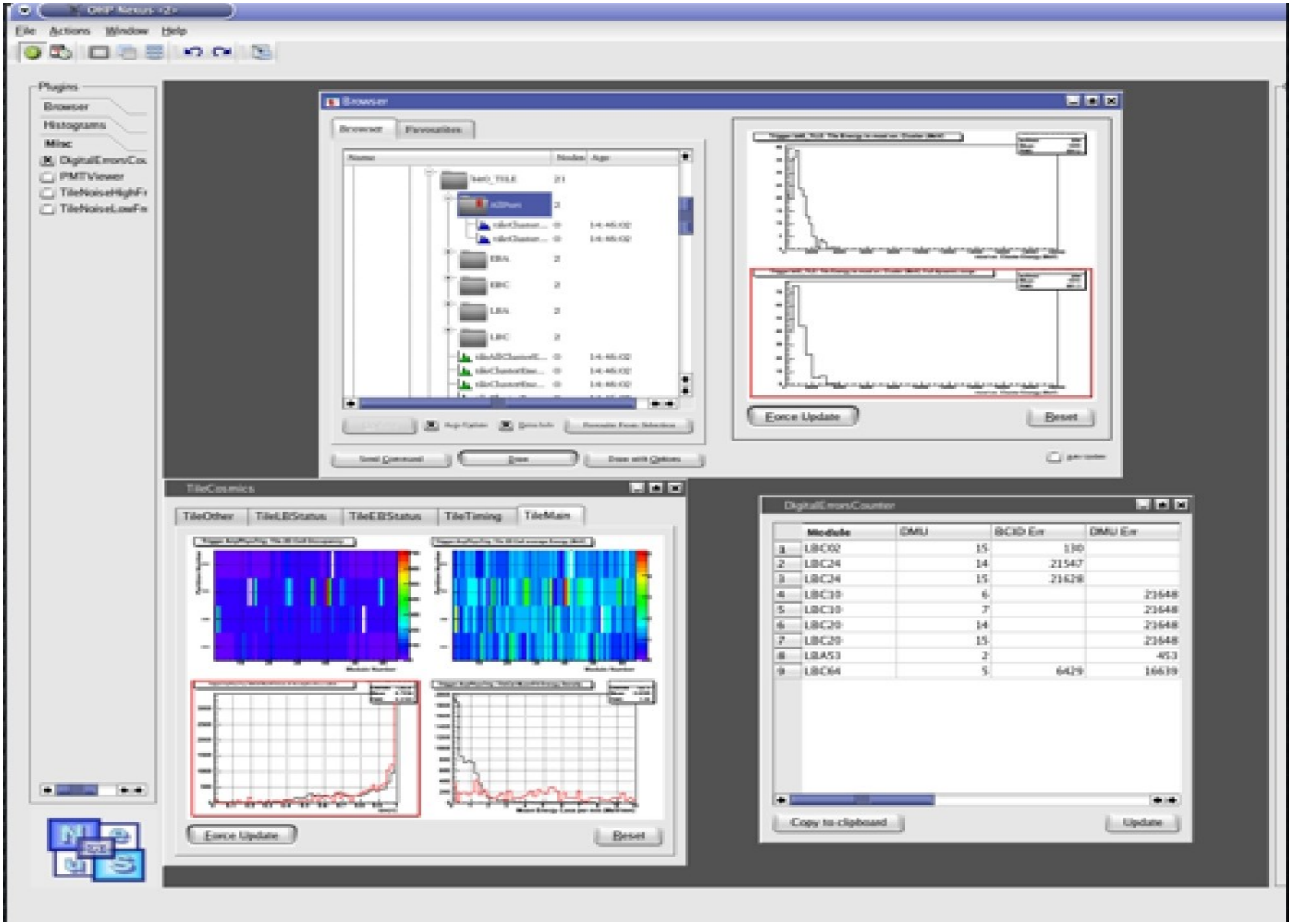
Trigger Checks: Decision and Reconstructed variables

Can run TrigHLTMonitoring (Tier0) analysis with some additional checks switched on (avoid duplication of code)

Can run also “private” user's code or Trigger Offline shifter jobs.


The provider publishes an histogram on the OHS server, OHP is notified about
OHP
Histogram Receiver
Cache
Notification Time Stamp T_n
OHS Server S
Filters
Core
Histogram H
Plugin
Provider P
Notification is forwarded to the plugin subscribed for it
OHP
Histogram Receiver
Cache
Notification S.P.H
OHS Server S
Filters
Core
Notification S.P.H
Plugin
Provider P
Following a plugin request, OHP core retrieve the histgram object from cache or from the
OHP
Histogram Receiver
Cache
Histogram H Requested
OHS Server S
Histogram H Requested
Filters
Core
Histogram H Requested
Plugin
Provider P
Plugin request histogram, OHP core retrieve it from OHS server
OHP
Histogram Receiver
Cache
Histogram H Time Stamp T_r
OHS Server S
Histogram H Forwarded
Filters
Core
Histogram H Forwarded
Plugin
Provider P

OHP


File Actions Window Help
Plugins
Browser
Histograms
Misc
DigitalErrorsCou
PMTViewer
TileNoiseHighFr
TileNoiseLowFre
Browser
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Force Update
Reset
TileCosmics
TileOther
TileLBStatus
TileEBStatus
TileTiming
TileMain
Force Update
Reset
DigitalErrorsCounter
Module
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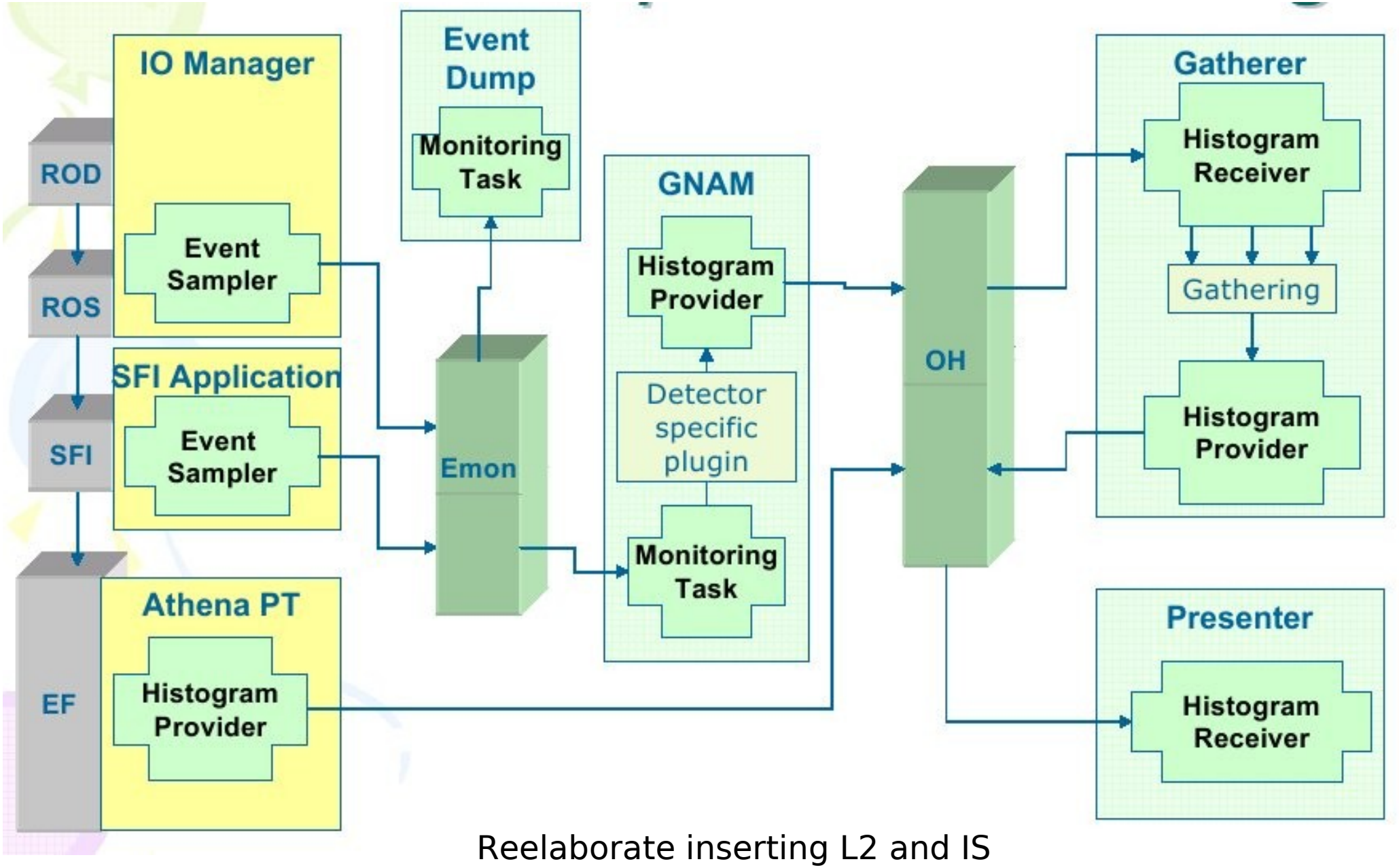
BCID Err
DMU Err
1 LBC02 15 130
2 LBC24 14 21547
3 LBC24 15 21628
4 LBC10 6 21648
5 LBC10 7 21648
6 LBC20 14 21648
7 LBC20 15 21648
8 LBA53 2 453
9 LBC64 5 6429 16639
Copy to clipboard
Update

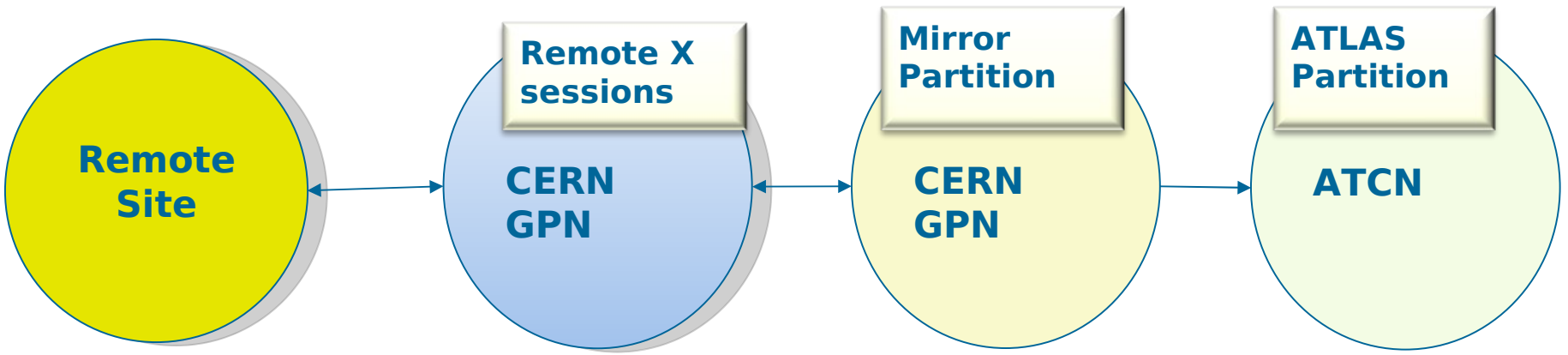
Monitoring Tools in ATLAS TDAQ



Reelaborate inserting L2 and IS

Remote Monitoring approach

- TDAQ Monitoring Working Group proposed and evaluated the following solution:
  - Run mirroring copy of the basic configuration and monitoring infrastructure services **outside** P1
  - Remote users can run the standard ATLAS Control Room X sessions on some dedicated machines **outside** P1



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