Dataflow Monitoring

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ALICE, ATLAS, CMS & LHCb joint workshop on *DAQ@LHC*

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Château de Bossey

NATIONAL ACCELERATOR LABORATORY

What Dataflow Monitoring Means

- Monitoring in real time **the flow of data** to ensure optimal data taking
  - from detector readout to permanent storage
  - trigger & DAQ quantities (counters, data rate, buffer occupancy, etc.)
- Avoid **dead-time**
  - and eventually allow to fix problems
- Each experiment uses its own jargon to indicate the same thing

Requirements

Basics

- Access any relevant information in real time to follow data taking
- Online aggregation & data correlation
- Online problem detection: dead-time, data losses, etc.

Added later

- Archive: access historical data for diagnostics, statistics, post-mortem
- Use monitoring data to trigger alarms and/or automatic actions to recover problems

Evolution

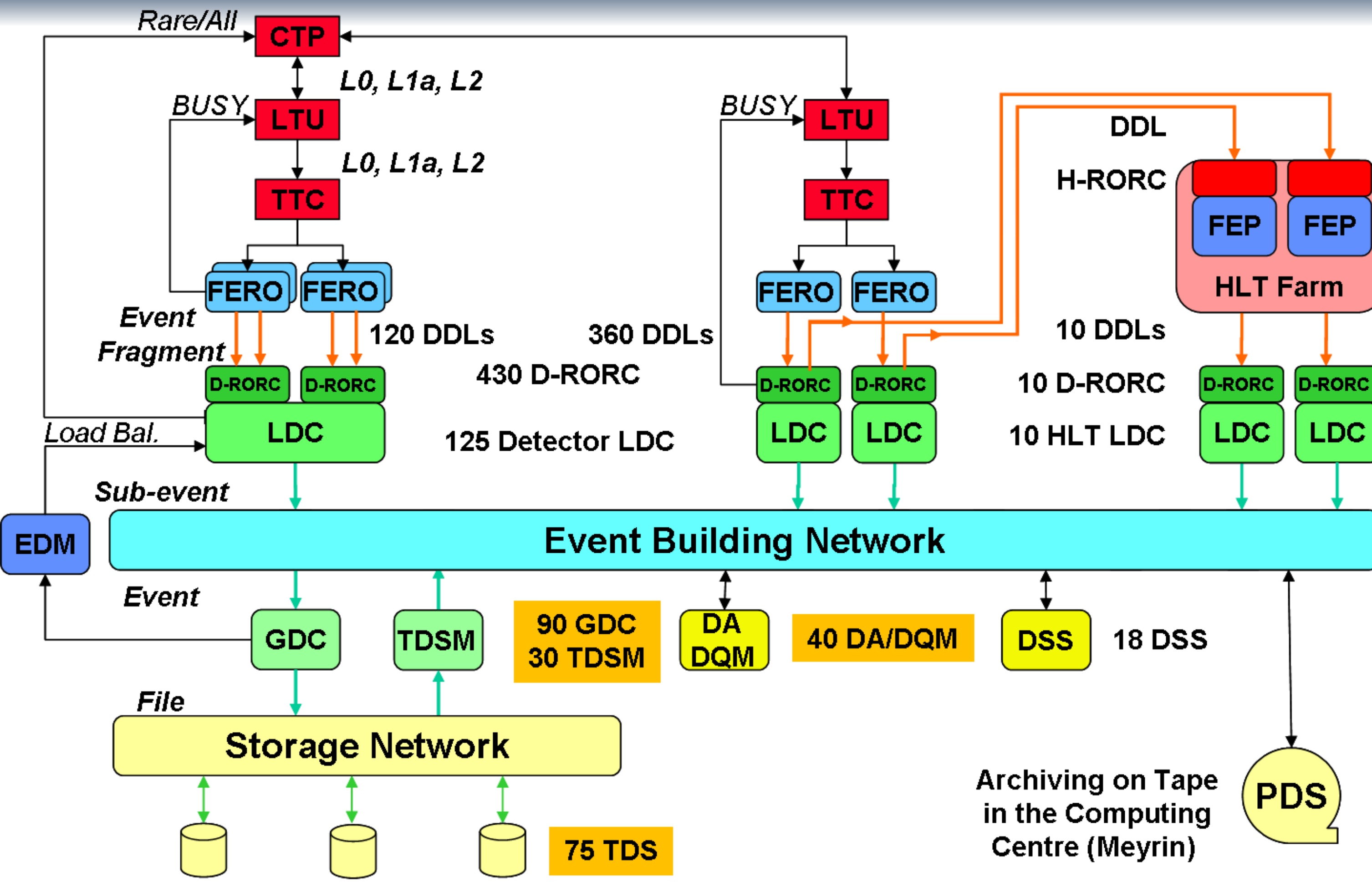
- Users: **shifters & experts**
- **LHC operations …at the beginning**
  - scattered information and rudimentary tools
  - shifters: intense monitoring activity
  - experts: high presence in control room + ringing on-call phone
- **LHC operations …routine**
  - coherent information and optimized tools
  - **automate** as much as possible to reduce shifter's tasks
    - see Luca's talk of this morning
  - move from custom GUI to ubiquitous **web based tools**
    - let's do all with a smartphone

THE 4 ARCHITECTURES

Middleware

- Each experiment developed **4 different DAQ systems** using different technologies
- Variety reflected in dataflow monitoring middleware
  - LHCb & ALICE: Distributed Information Management (**DIM**)
    - client/server paradigm, light weight
  - ATLAS: Information Service (**IS**)
    - custom library on top of CORBA
    - client-server communication model where information is stored in memory by so called IS servers
  - CMS: **Web Service**
    - Cross-DAQ (**XDAQ)** framework

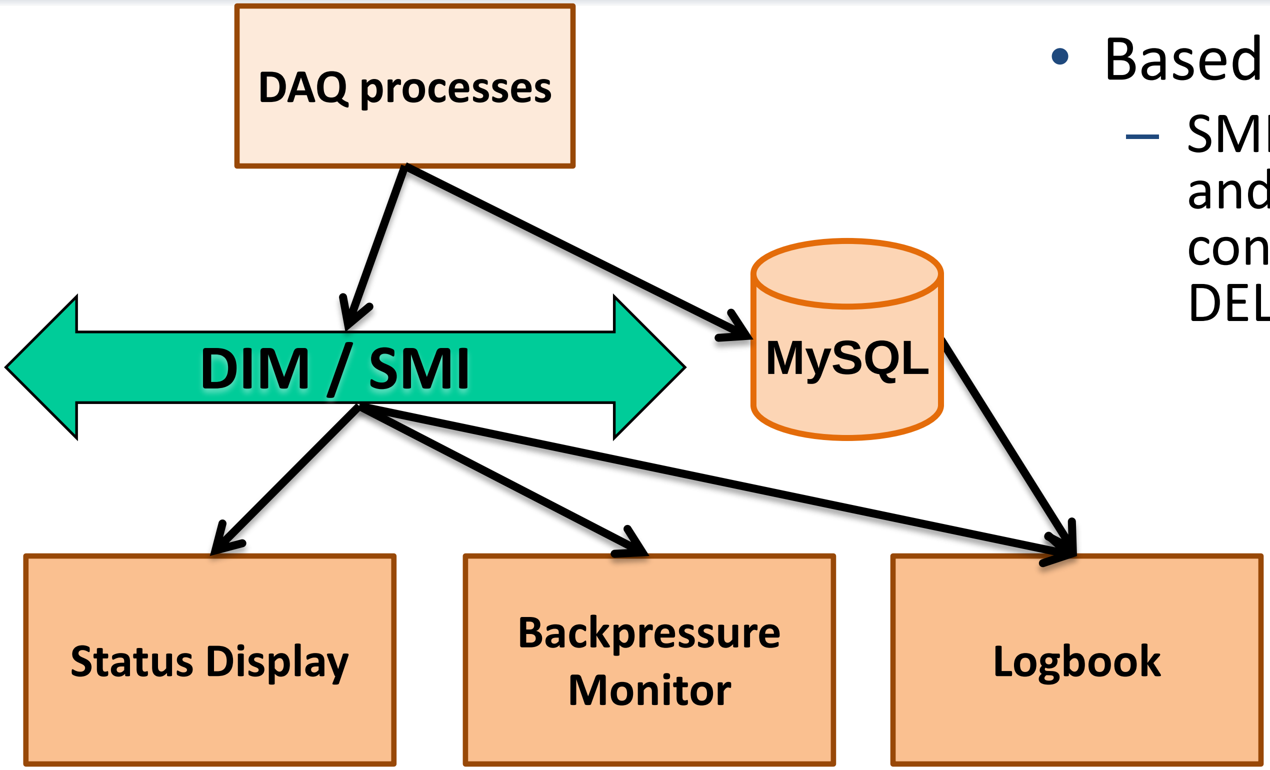
ALICE DAQ



NOTE:
HLT monitoring & dedicated expert storage monitoring not discussed here

- ~300 processes on ~300 machines
- 100k **dataflow information** published every 5 s → **~3 GB/h**

ALICE Dataflow Monitoring Architecture



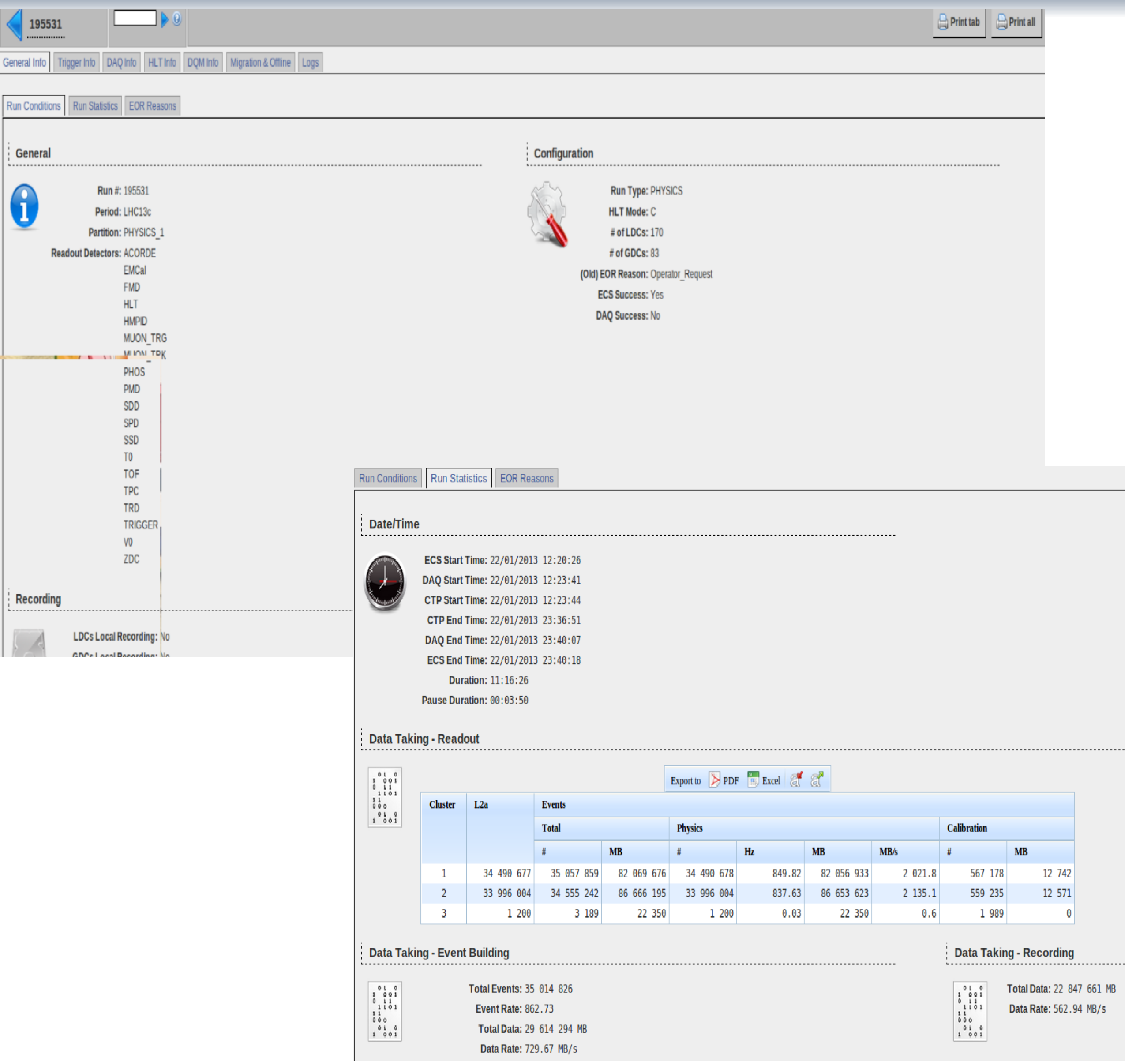
- Based on **DIM/SMI**
  - SMI: framework for designing and implementing distributed control systems developed by DELPHI

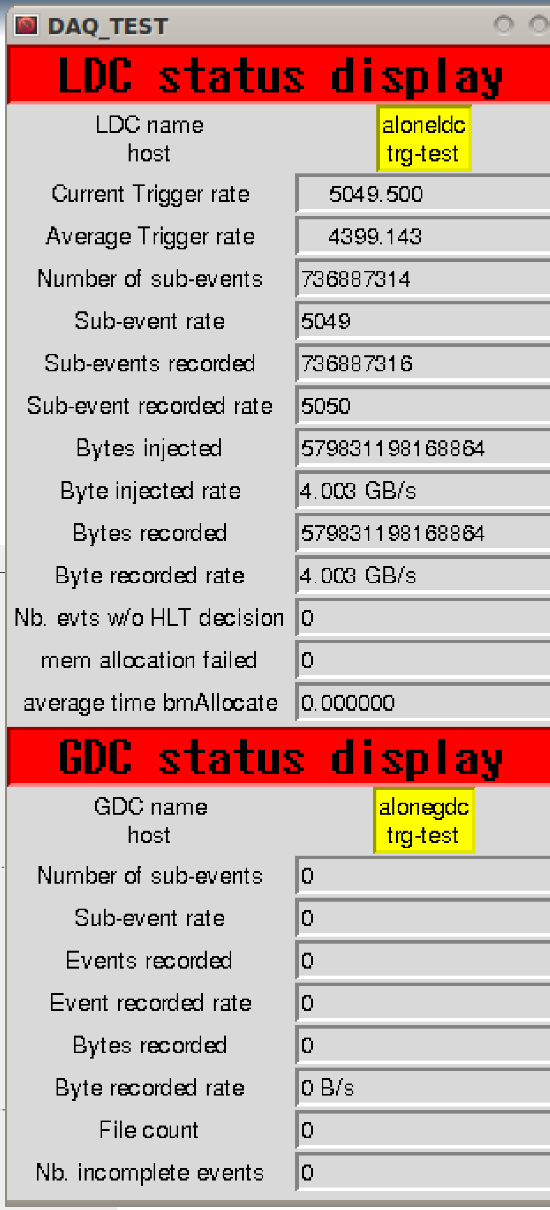
- **MySQL**:
  - store system configuration
  - LDC&GDC write run info
  - Archive.
    - Logbook as visualization

- **2 monitoring applications**
- Tcl/Tk

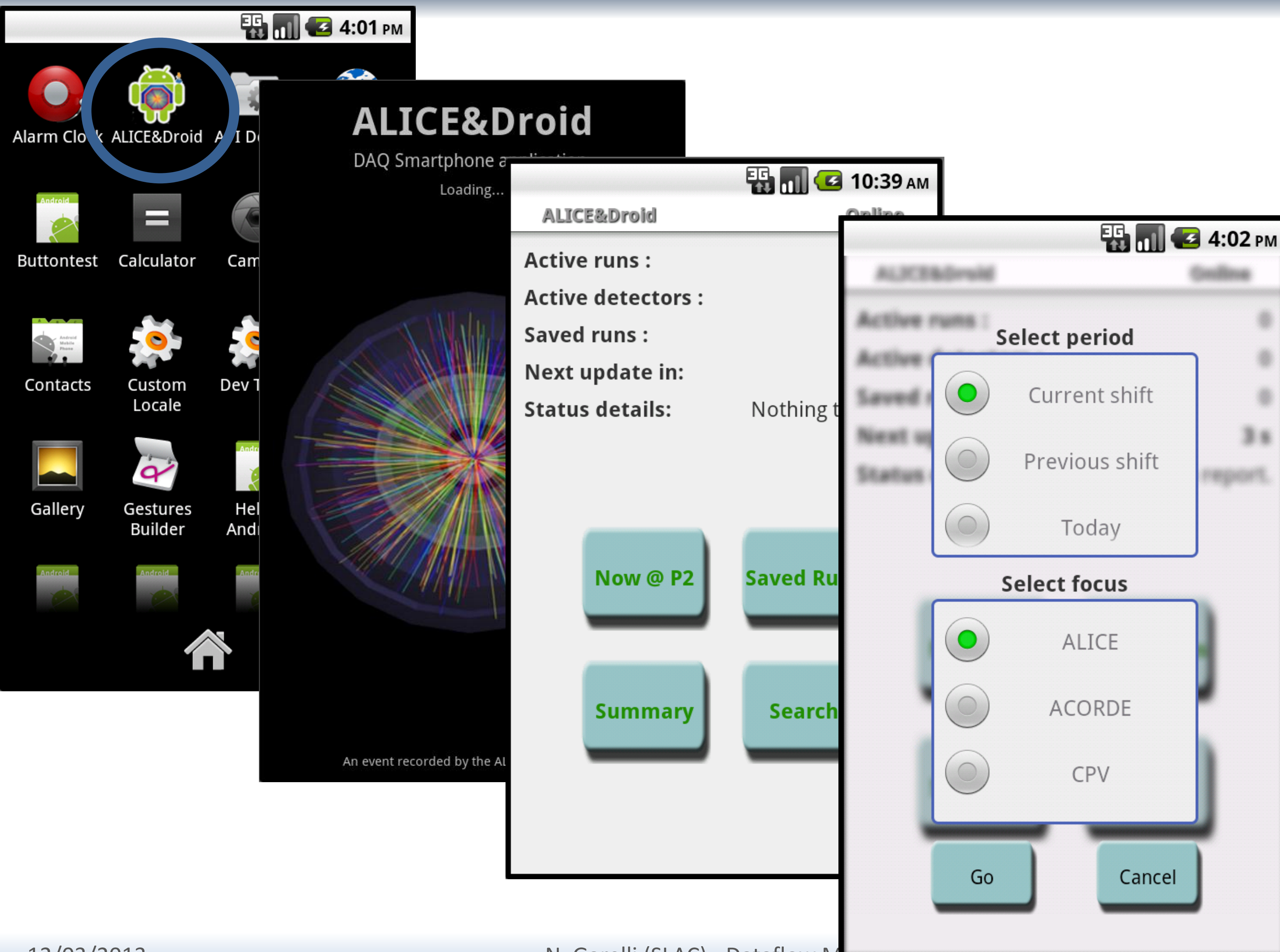
- **“Logbook”**
  - much more than what you think
  - PHP

ALICE Visualization

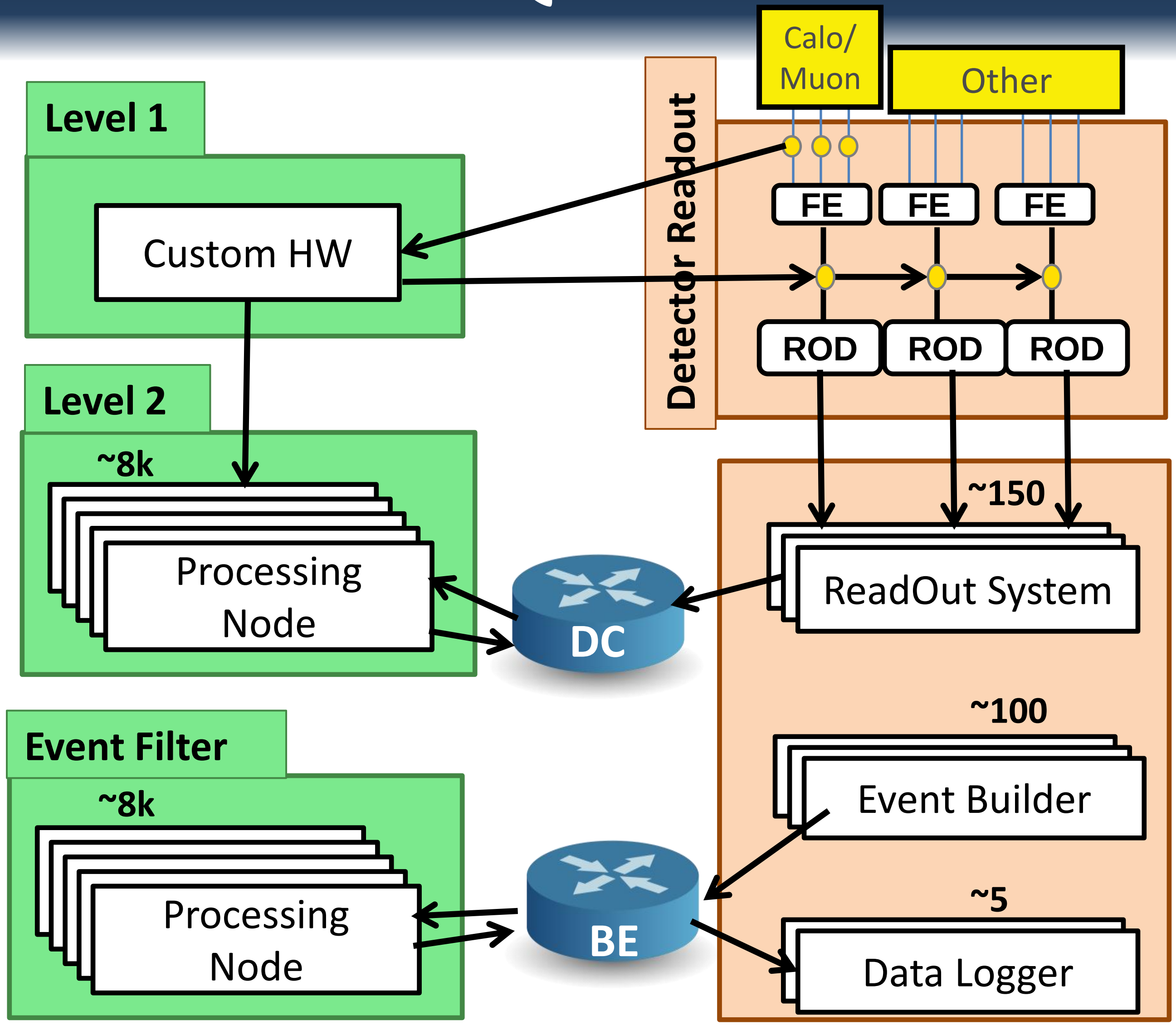




ALICE & Android



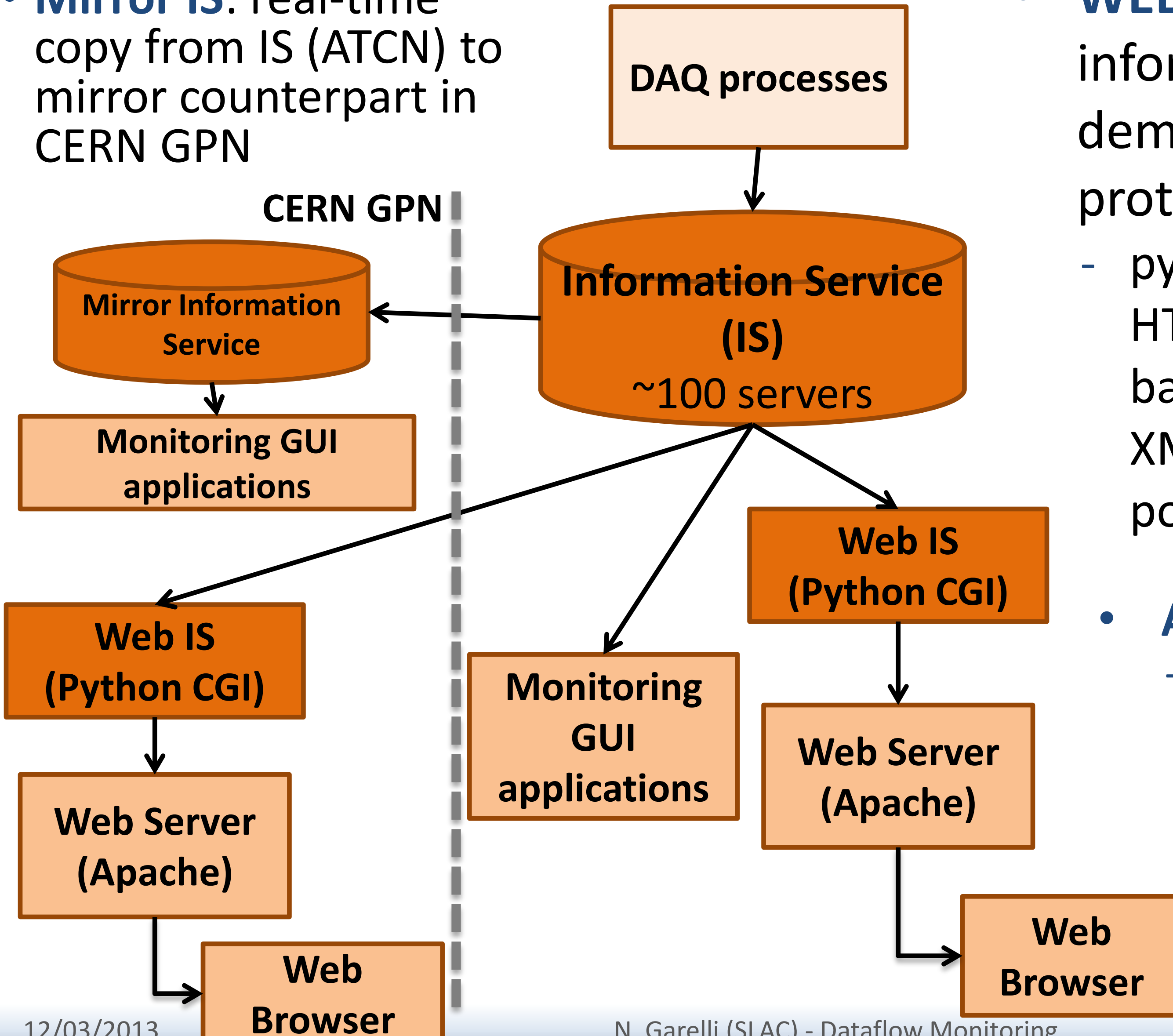
ATLAS DAQ



- O(20k) processes on ~2k machines
- 1M dataflow information published every 5-10 s → **~4 GB/h**

ATLAS Dataflow Monitoring Architecture

- **Mirror IS**: real-time copy from IS (ATCN) to mirror counterpart in CERN GPN

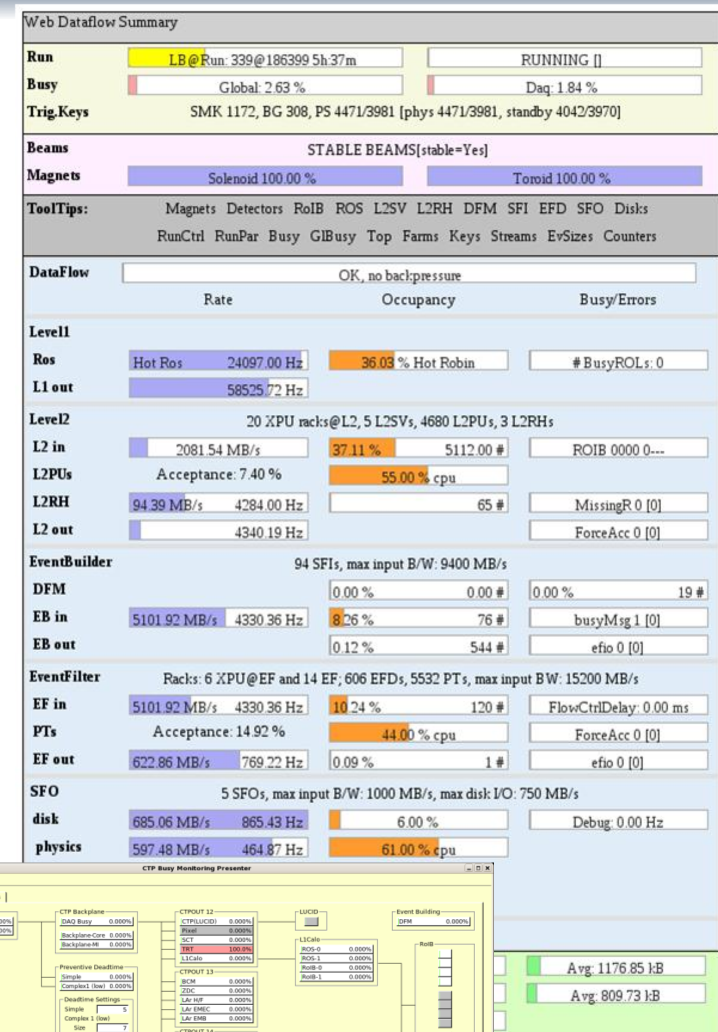


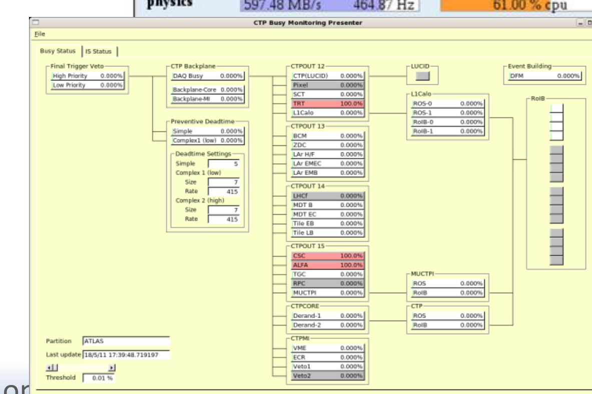
- **WEB IS**: IS gives information access on demand via HTTP protocol
  - python wrapper accepts HTTP requests & sends back dynamically formed XML text (value of IS obj pointed by given URL)

- **Archive**: None.
  - information stored & accessed for ~2 month in RDD files each ~30 s via network monitoring system

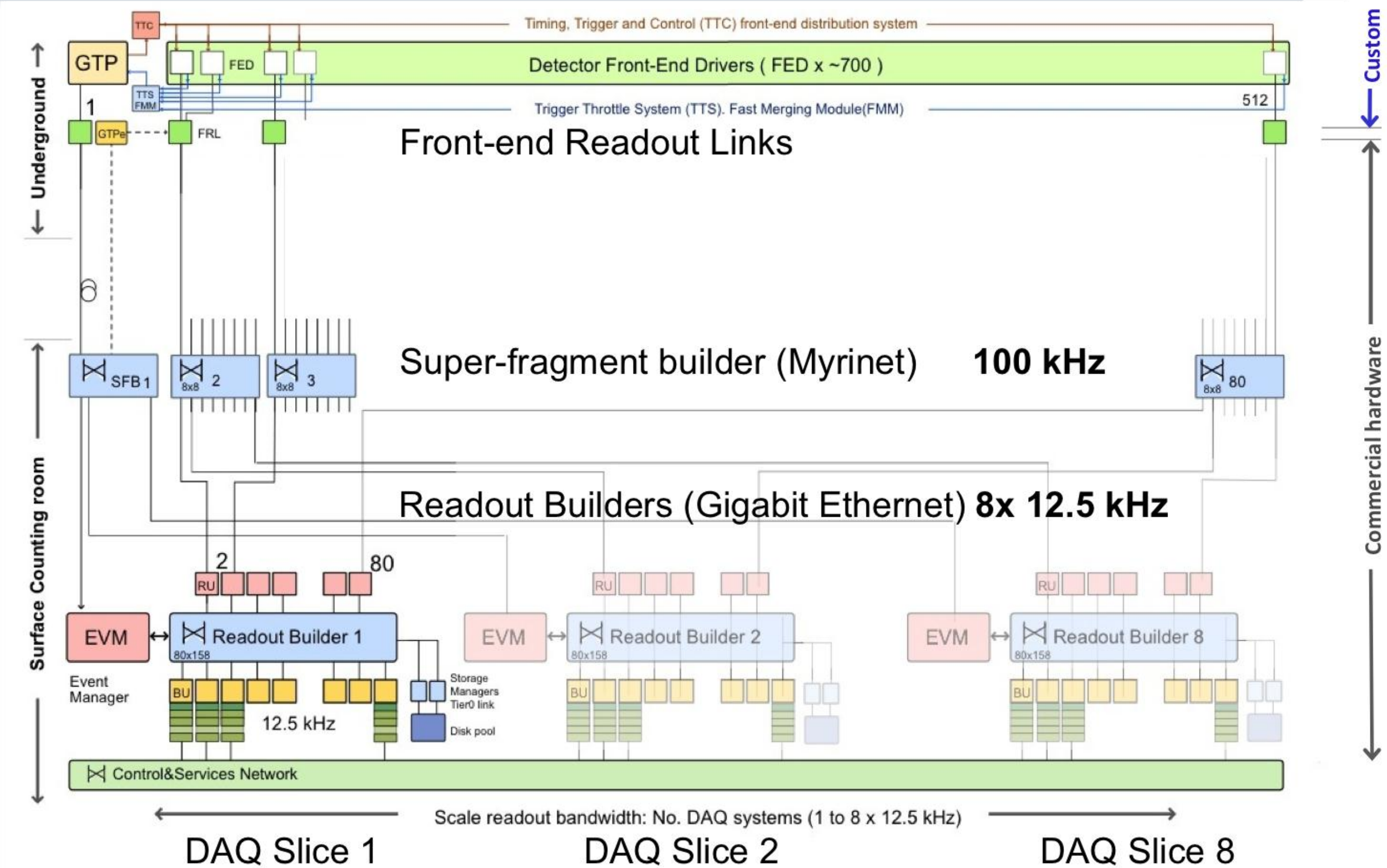
Shifter's Tools in 2012

- **DAQ Panel**: tool portal for shifters
- **DFSummary**
  - dynamically constructed web page which computes & displays most important dataflow parameters (~200 variables)
  - ~30 s update rate
- **Busy Panel**: Qt application for monitoring dead-time
- **Shifter Assistant**
  - see Luca's talk of this morning



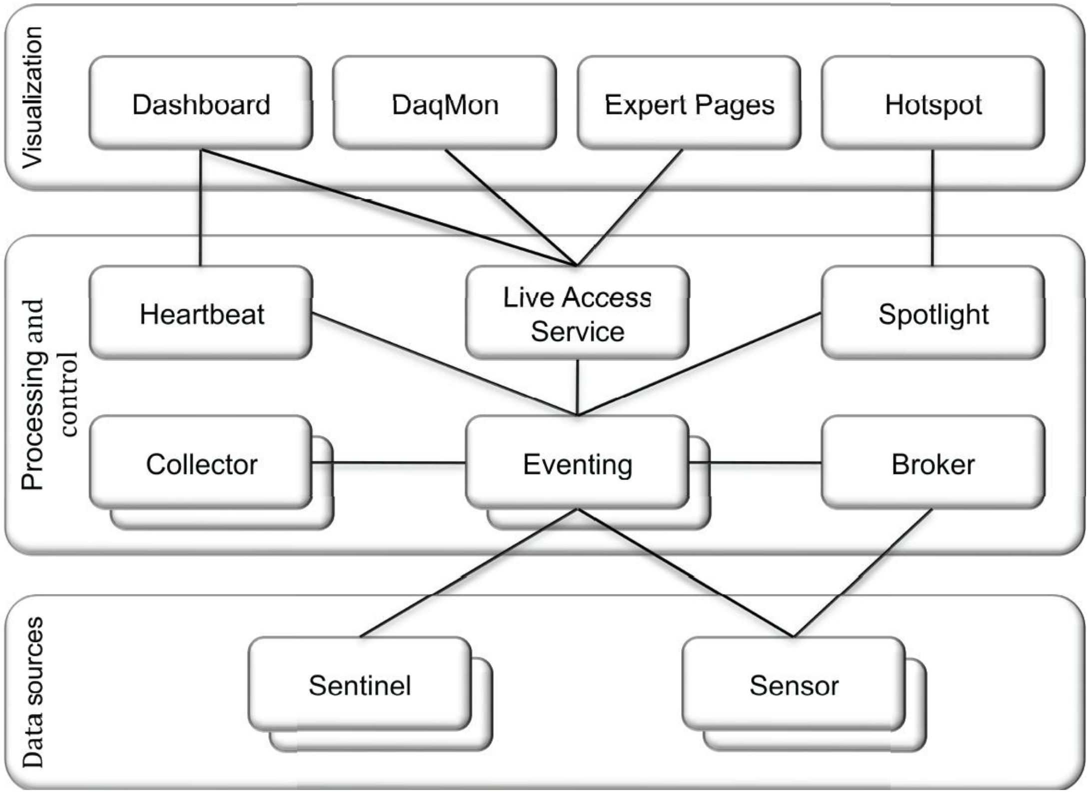


CMS DAQ



- O(20k) processes on ~2k machines
- O(600k) dataflow information published every 1-5 s → **~8 GB/h**

XDAQ Monitoring & Alarming Service

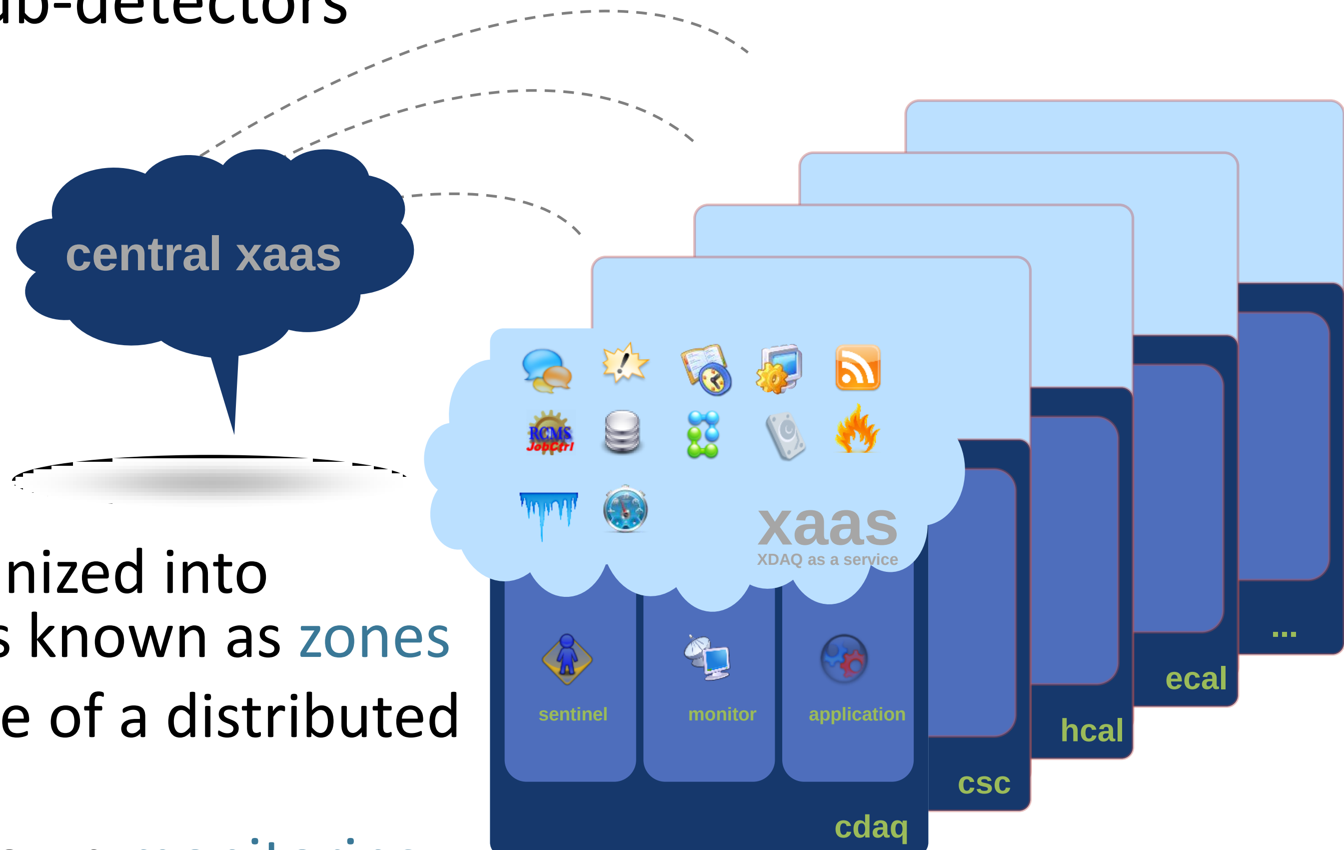


- **Archive**: automatic persistency of collected tables in ORACLE according to configuration
  - Subset of information stored: ~30 GB/y

- Fully scalable distributed monitoring & alarming system
- Service-oriented architecture organized in 3-tier structured collection of communicating components:
  - **Sensor**: report monitoring data
  - **Eventing**: scalable publisher-subscriber service orchestrated by a load balancer application (**Broker**)
  - **Collector**: build relational tables
  - **Live Access Service**: presentation of raw data (**Web Service**)

Monitoring as a Service

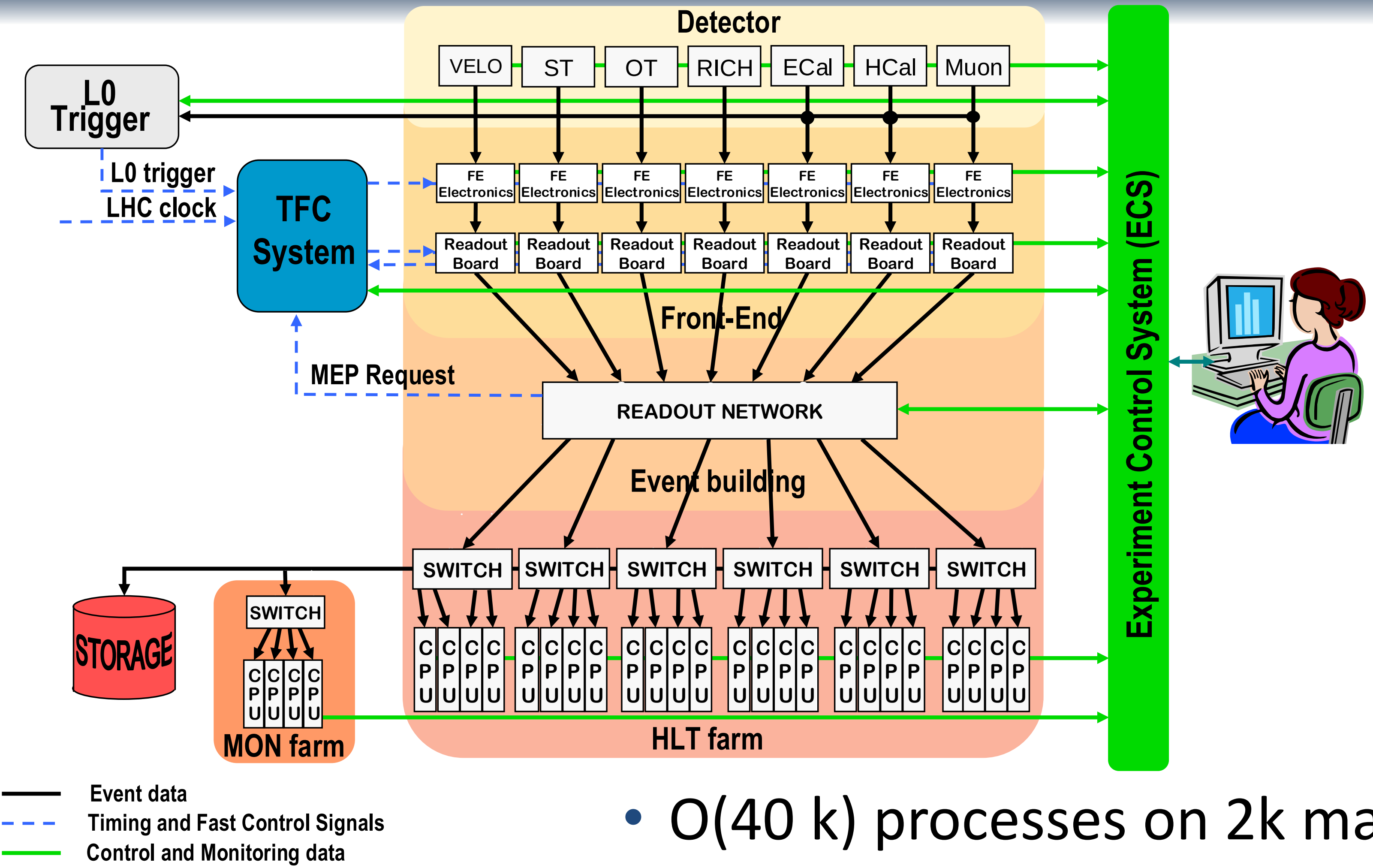
- XDAQ as a Service (**XaaS**): common infrastructure for both central DAQ & sub-detectors
- interoperable services providing standard functionalities for use in XDAQ environment
- All processes organized into searchable groups known as zones
- zone defines scope of a distributed XDAQ application
- Each zone has its own monitoring data types (flashlists)



CMS Visualization

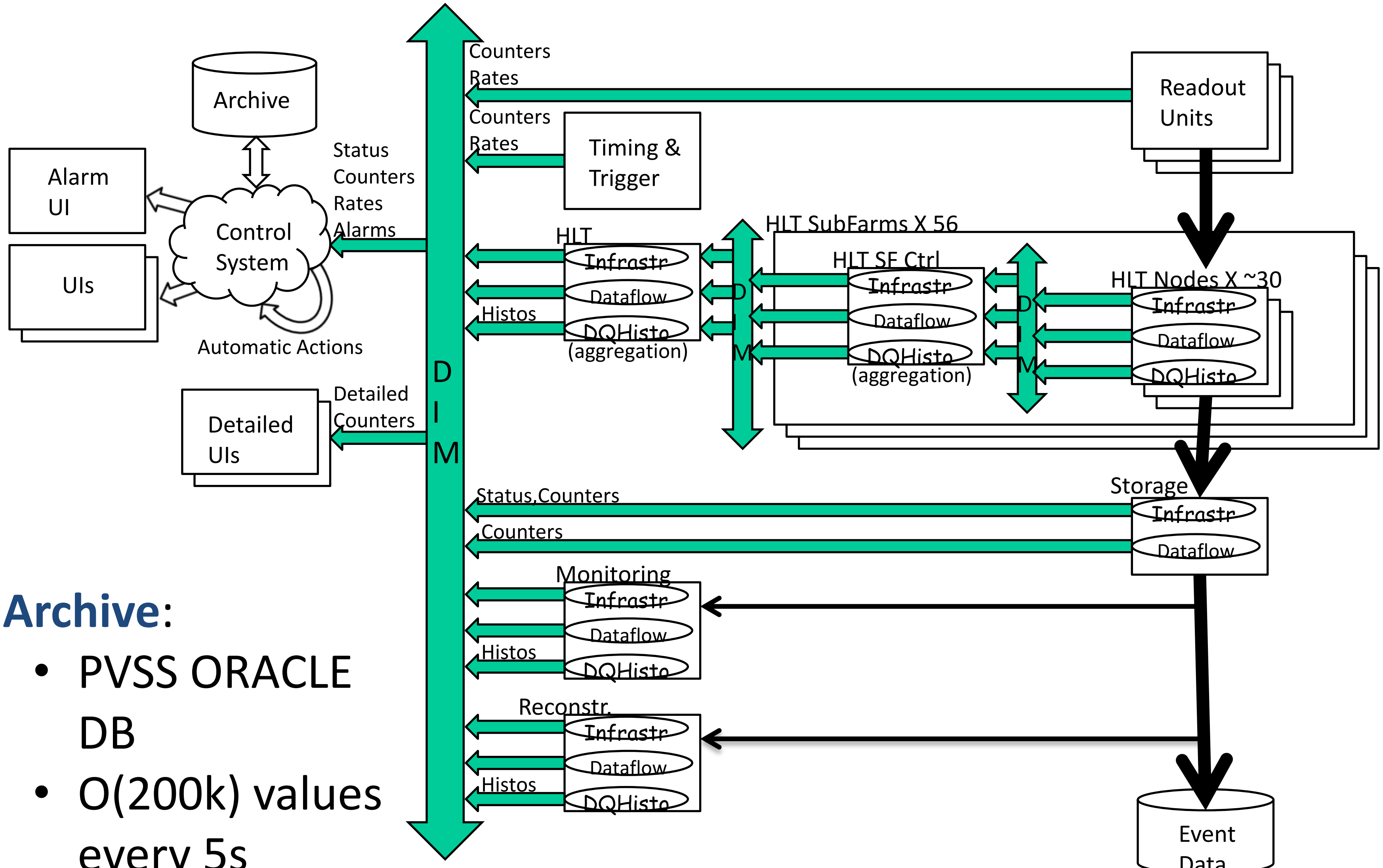
- **LabView DAQMon**

LHCb DAQ



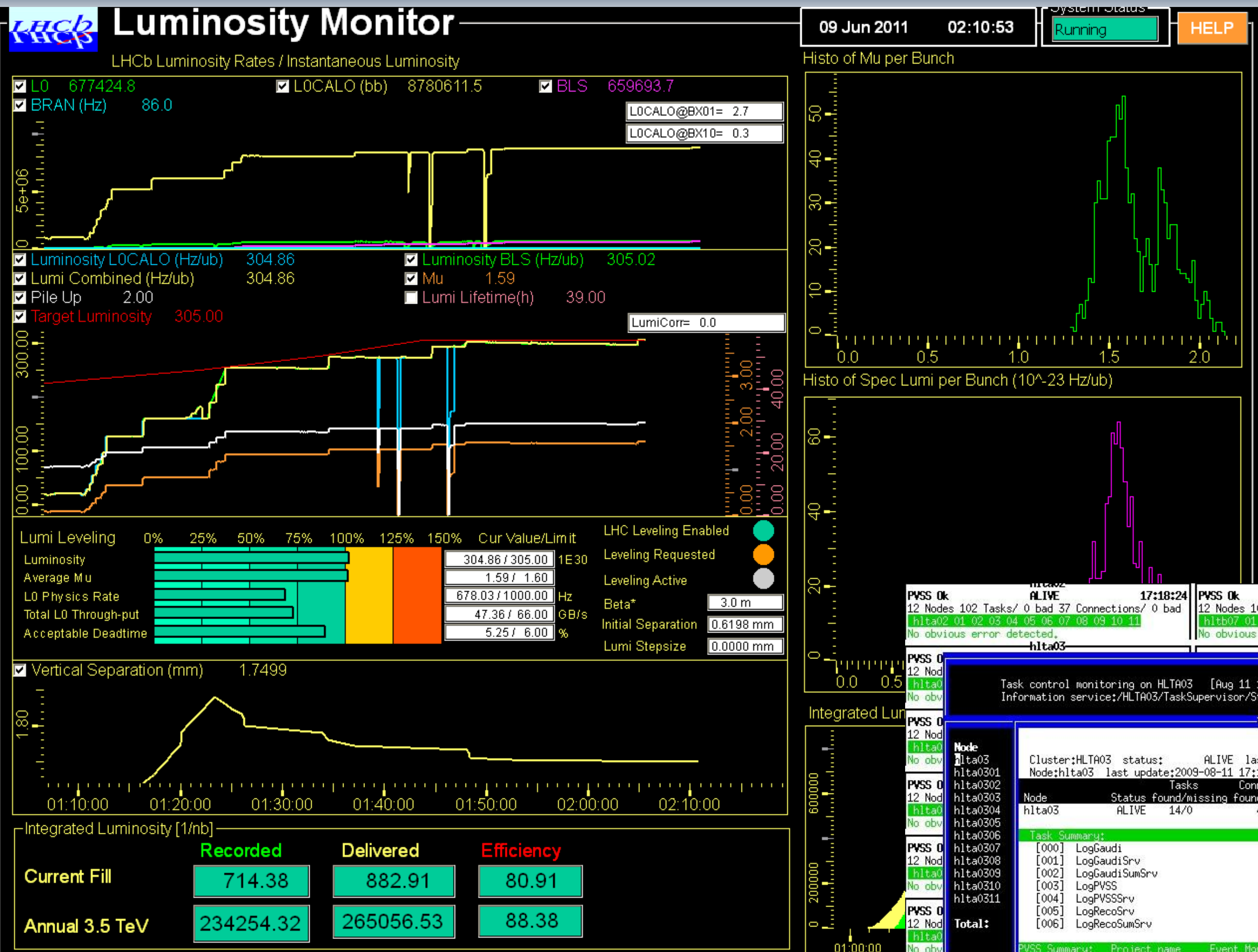
- O(40 k) processes on 2k machines
- 4M dataflow information published every 5s → **~ 11.5 GB/h**

LHCb Dataflow Monitoring Architecture

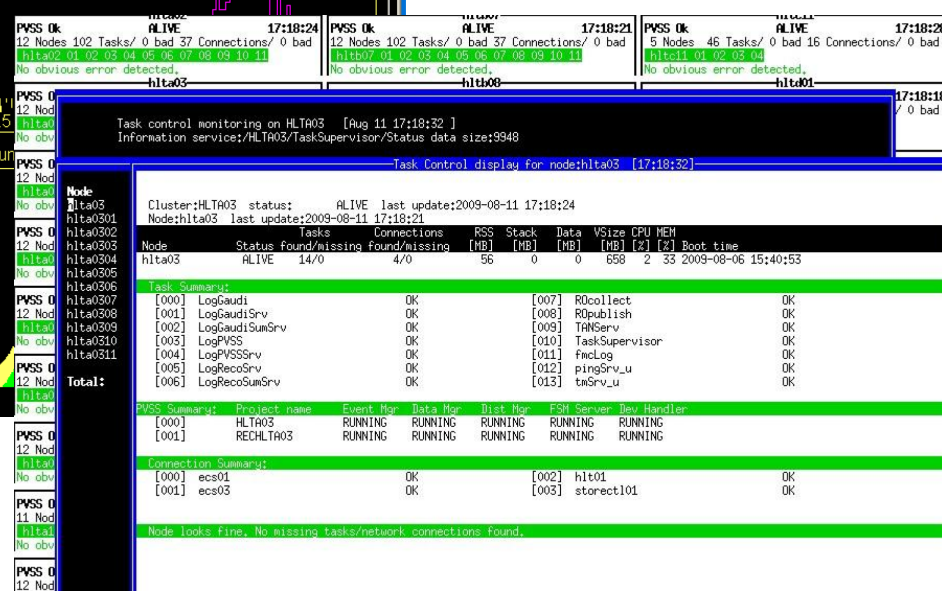


Archive:
- PVSS ORACLE DB
- O(200k) values every 5s

LHCb Visualization



PVSS GUI



VT100 graphics

detailed UI

CONCLUSIONS

Satisfied?

"**YES**, it does the job"

" … **BUT** …"

- 4 different solutions for the same problem …
- sharing experience and maybe even future common solutions?

→**Luciano's talk on Thursday**