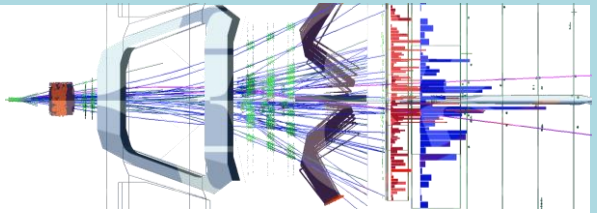

Simultaneous usage of the LHCb HLT farm for Online and Offline processing workflows

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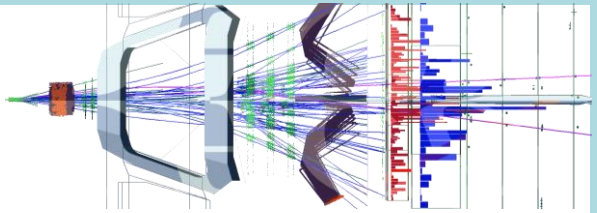
On behalf of the LHCb collaboration

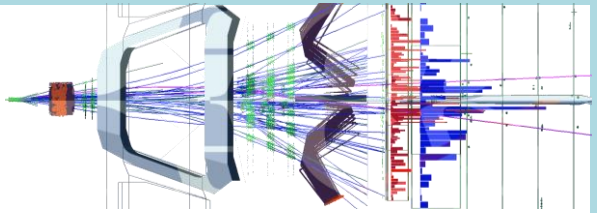


Introduction

LHCb is one of the 4 LHC experiments and continues to revolutionize data acquisition and analysis techniques.

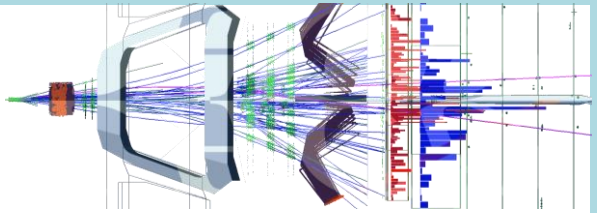
Concepts of “online” and “offline” analysis unified:

- calibration and alignment take place automatically in real time and are used in the triggering process such that Online data are immediately available offline for physics analysis (Turbo analysis),
  - (see talk from C. Bur : LHCb full-detector real-time alignment and calibration: latest developments and perspectives)
- HLT farm used simultaneously for different workflows
  - synchronous first level trigger
  - asynchronous second level trigger
  - Monte-Carlo simulation

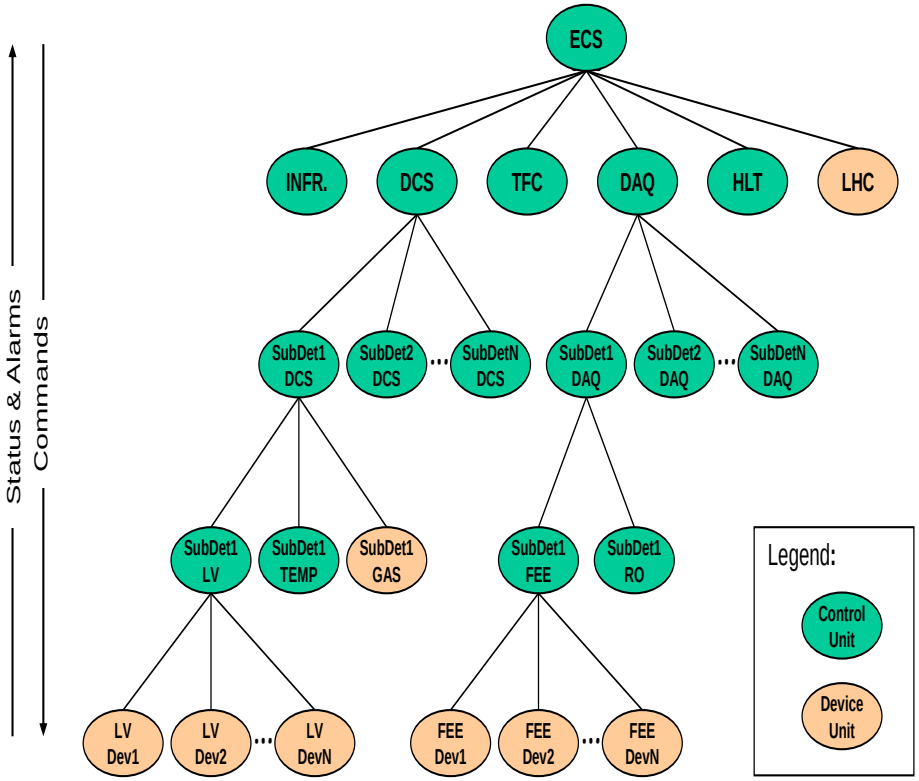


HLTFarm environment

- HLTFarm is composed by ~1500 PCs, distributed over ~60 subfarms.
- These subfarms are logically divided in the Control System and each subfarm row is composed with 24 or 28 or 32 PCs each
- Each of the subfarms is controlled by a controller PC with WinCC OA installed – which manages the HLT tasks on the HLT nodes.
- These controller nodes are also connected to a top level HLT control node, which manages the availability and allocation of the subfarms for the global Experiment Control System (ECS).
- Each HLT node have minimum 24 CPU (Hyper-)Cores and local disk partioned for various activities

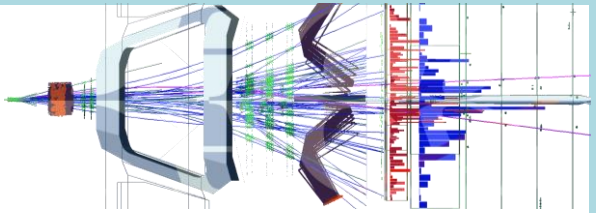


Control System ECS



Control System (ECS) in LHCb is based on the SCADA WinCC OA with custom LHCb developed components.

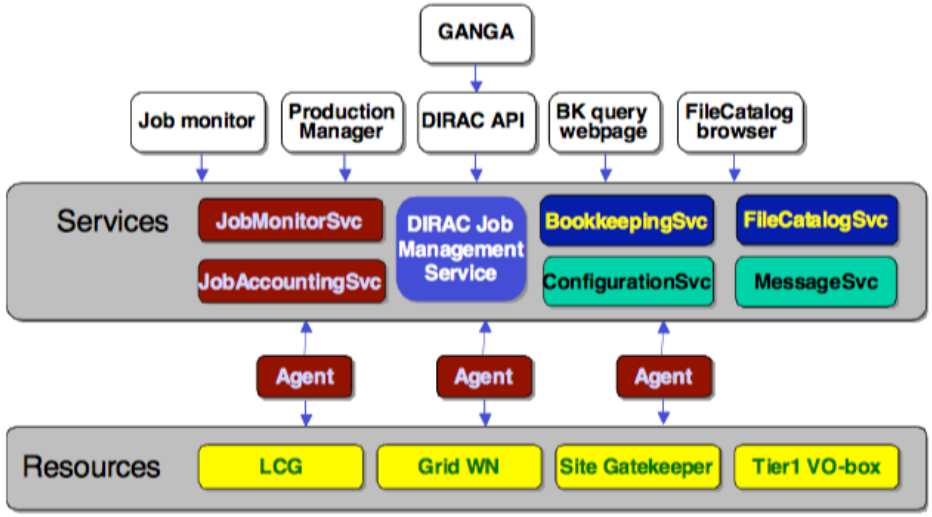
- ECS controls the whole experiment:
  - Front End electronics
  - HLT
  - DAQ
- ECS is able to configure the whole experiment based on the different states of the LHC accelerator
- We wanted to integrate also in ECS the configuration of the production tools for Offline activities (DIRAC)

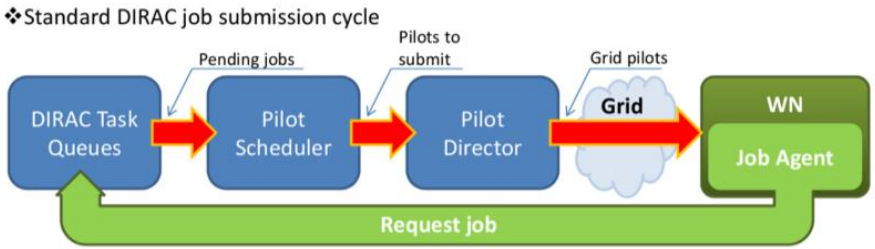


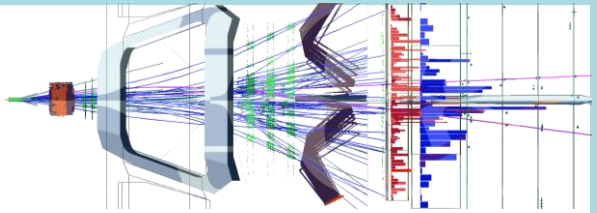
DIRAC

DIRAC Script : task started on each worker node

- sets proper computing environment
- launches the Agent
  - query the DIRAC Workload Management System to check if there is some task to be executed.
- If the Agent gets a job
  - execution in the local disk where the input data, if any, will be downloaded and the output will be written.
  - At the end of the task, the ouput(s) will be uploaded to the Storage located in the Computer Center.
- During the execution of the task, information sent to DIRAC monitoring to follow the progress of the job.

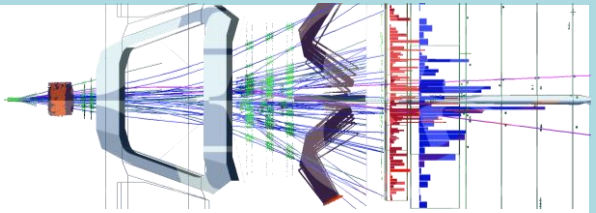




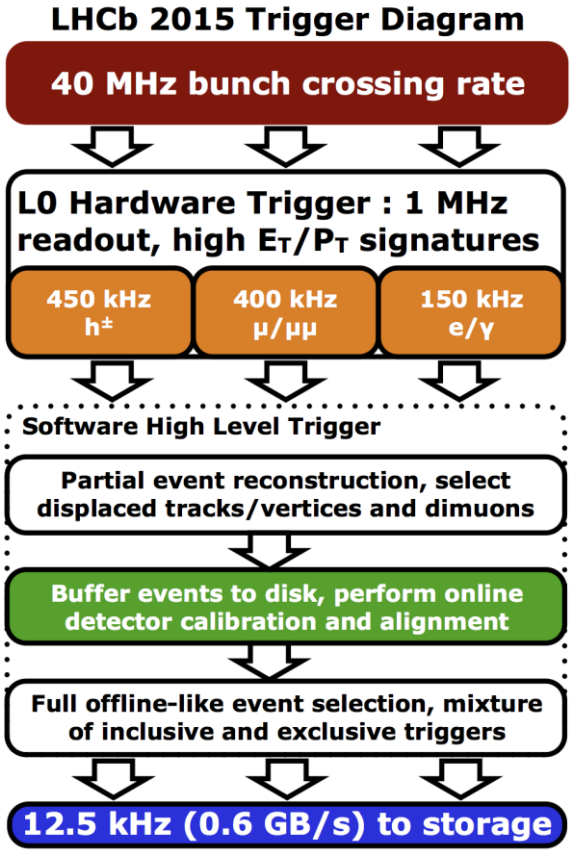


LHCb software environment

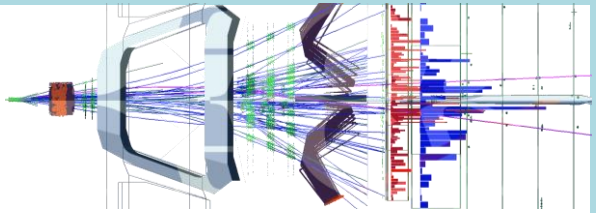
- LHCb is using CVMFS to distribute all the LHCb applications
- CVMFS is mounted on all the computer center that are providing computing resources for LHCb
  - Grid centers : T1, T2
  - HLTfarm
- The environment in which the LHCb applications is running is also based on CVMFS



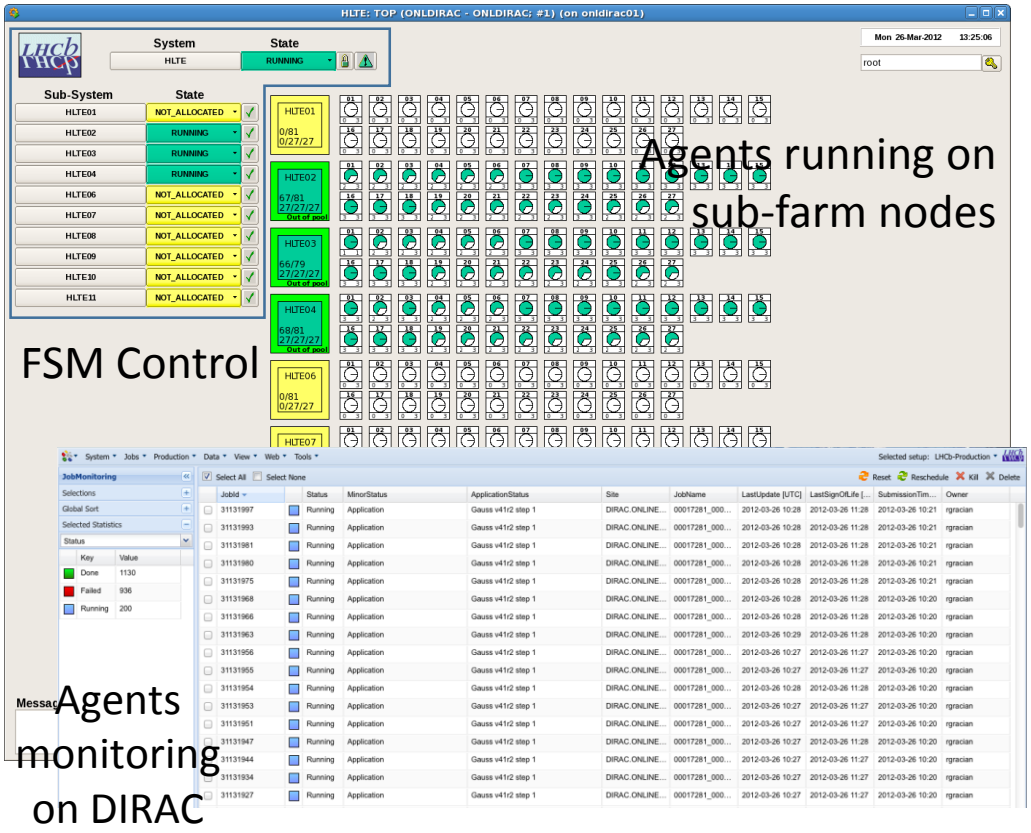
LHCb Workflows used in the HLTFarm



- HLT1 runs **synchronously** and reduces rate from 1MHz to about 100kHz
- HLT2 runs **asynchronously** on HLT1 output buffered to disk and reduces rate to about 12kHz
  - HLT is completely software based and runs on a dedicated computer farm with ~1500 PCs totalling over 50.000 (Hyper) cores.
  - HLT software installed on CVMFS
- Monte-Carlo simulation
  - DIRAC jobs during idle cycle if tasks are available
  - Simulation software install on CVMFS



WinCC OA

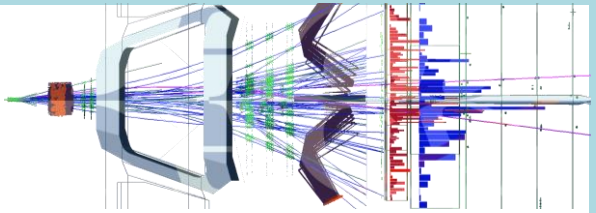


FSM Control

Agents running on sub-farm nodes

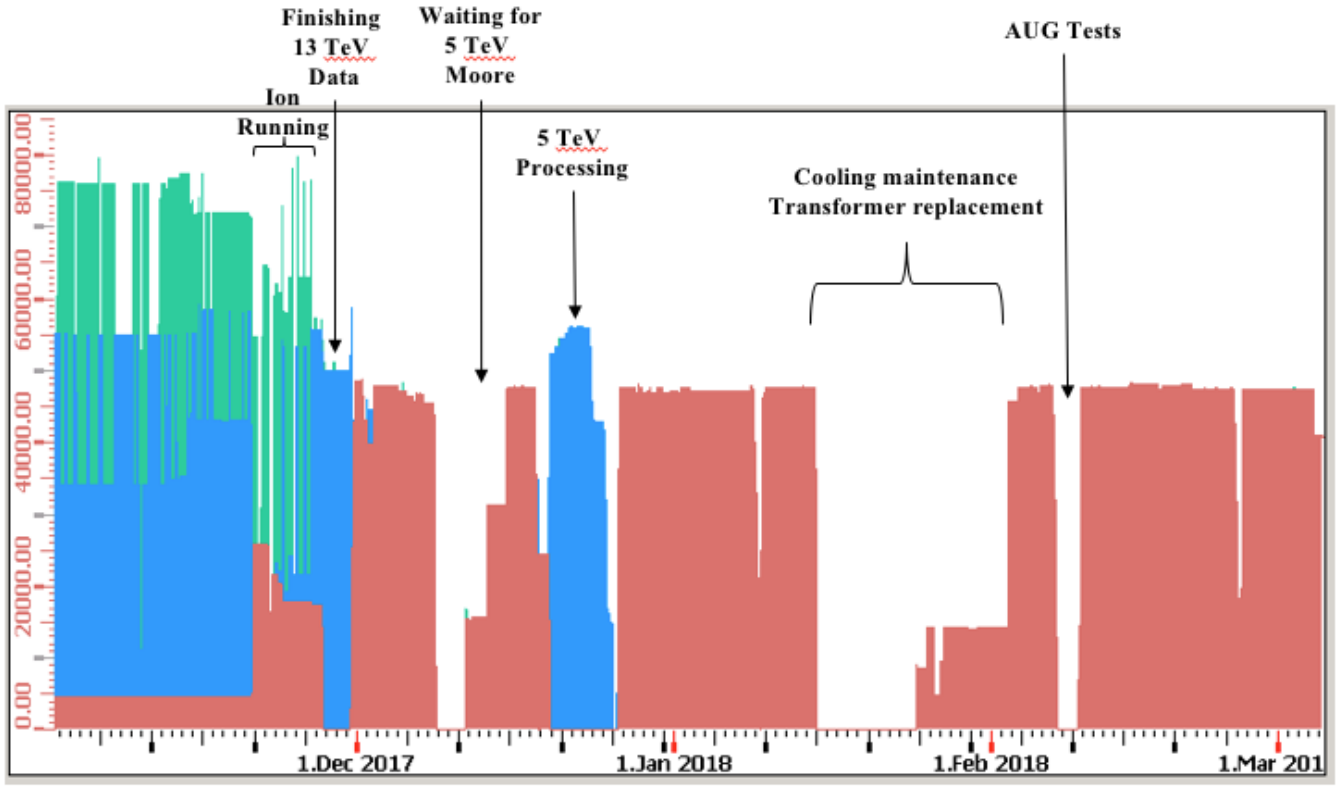
Agents monitoring on DIRAC

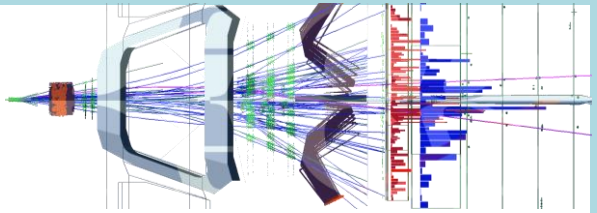
- Each node is independant
  - Settings are individual per machine
- All tasks controlled by WinCC OA on each nodes
  - Possibility to set the exact number of jobs on each machine
  - Possibility to set automatically the number of jobs depending on the machine CPU
  - In case of automatic configuration, the number of cores to be left unused (for DIRAC) can be set
- No need to change the settings of the node to switch between task
- Can easily utilize just a part of the farm (in case some is needed for data taking/tests)



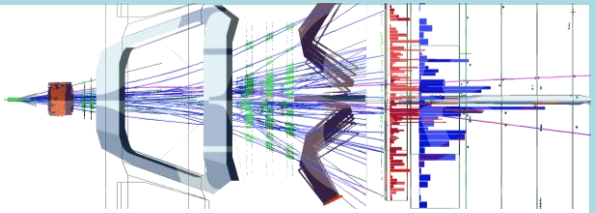
Activities during Christmas shutdown

- Mostly trying to run as much Monte-Carlo production as possible



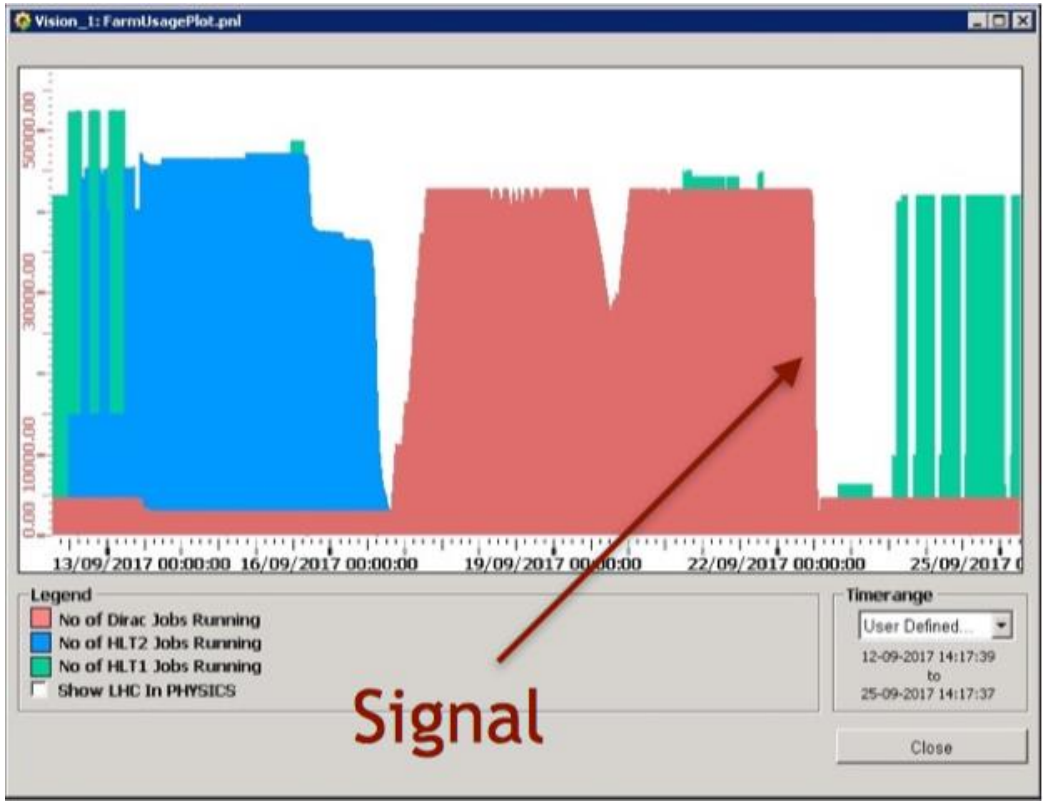


Activities during data taking startup

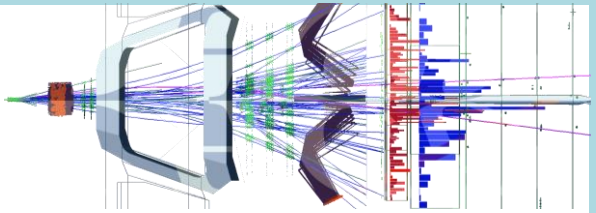


Switching HLTFarm configuration

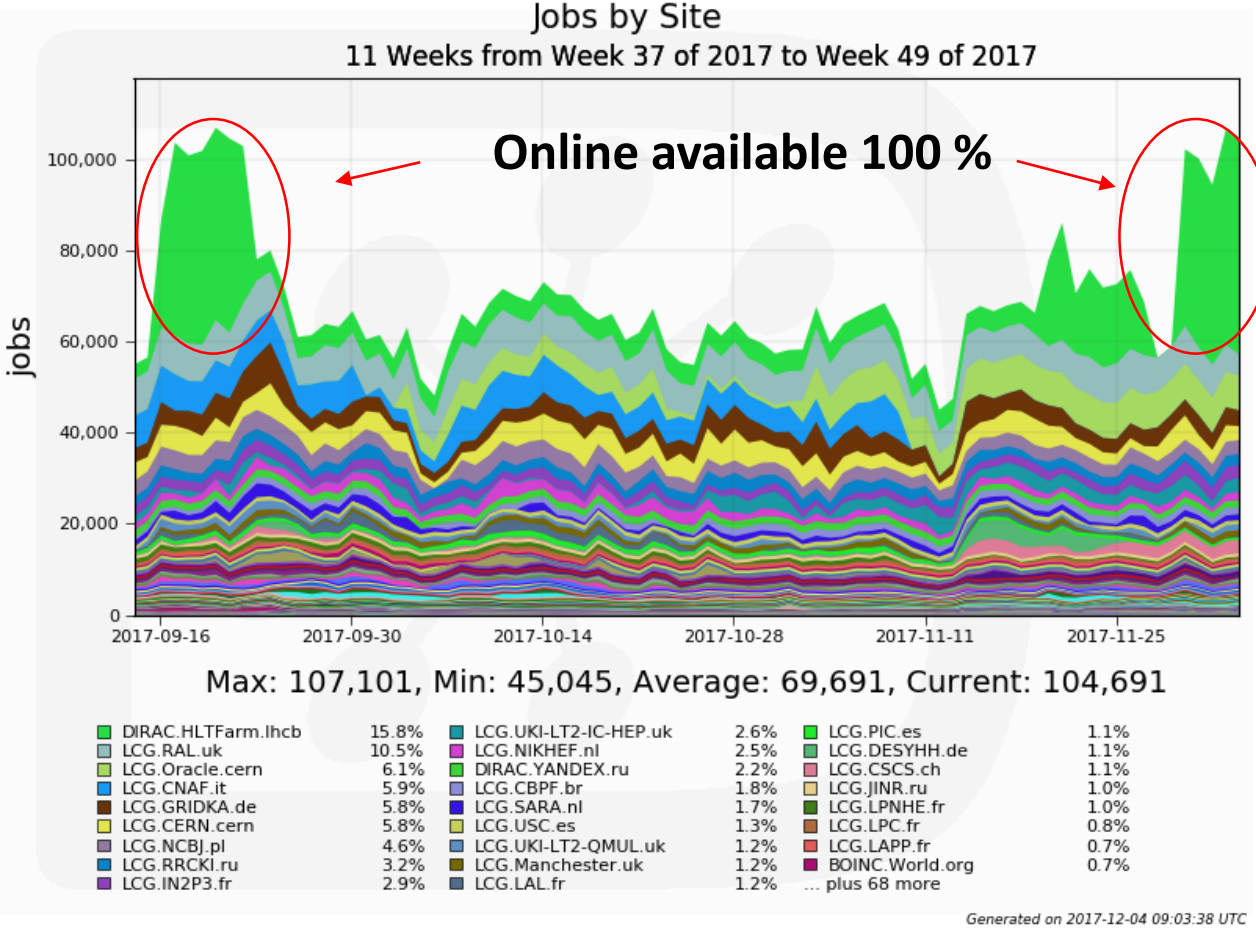
In 2017 the HLT team added the ability to use the LHCb application signal handling to interrupt running Monte Carlo jobs cleanly from the WINCC OA when HLT jobs slots are needed again

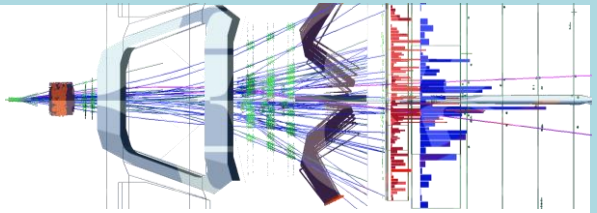


See Talk from A. McNab
Interruptible LHCb Monte Carlo jobs
Track 3 Tuesday

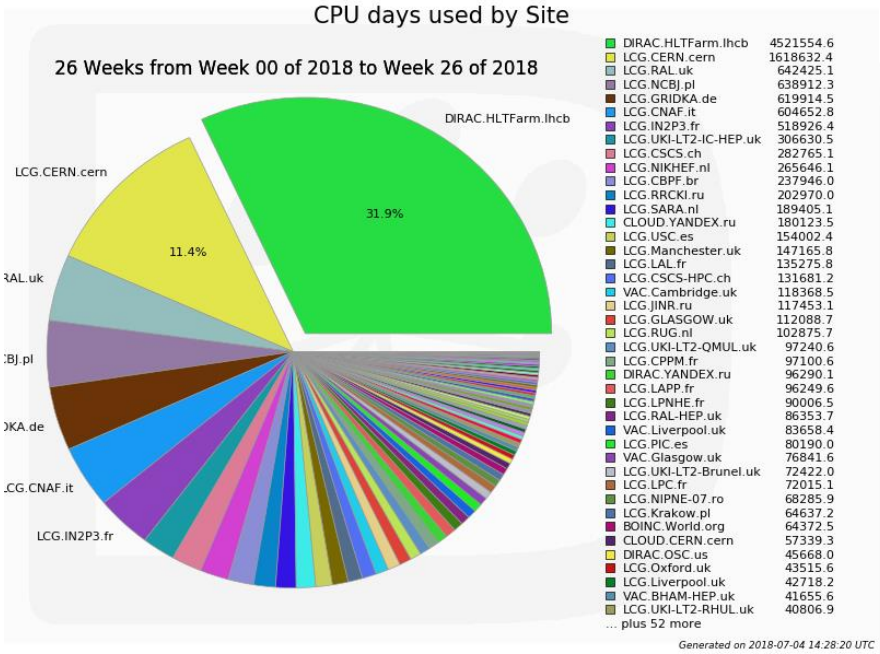


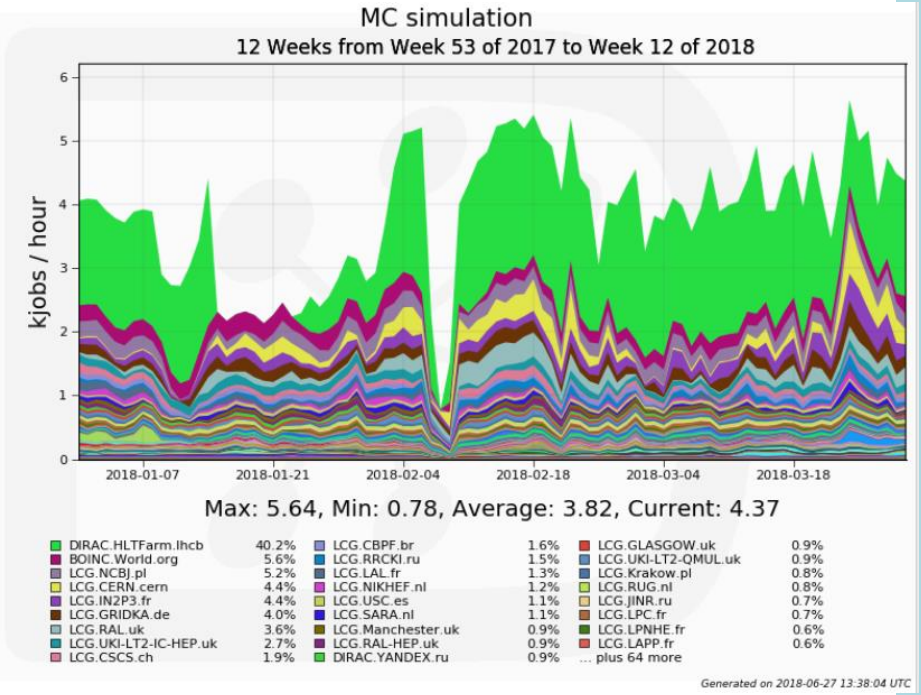
HLTFarm usage during 11 weeks

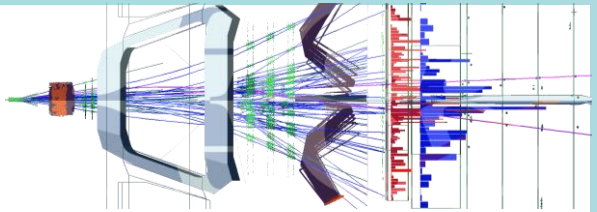




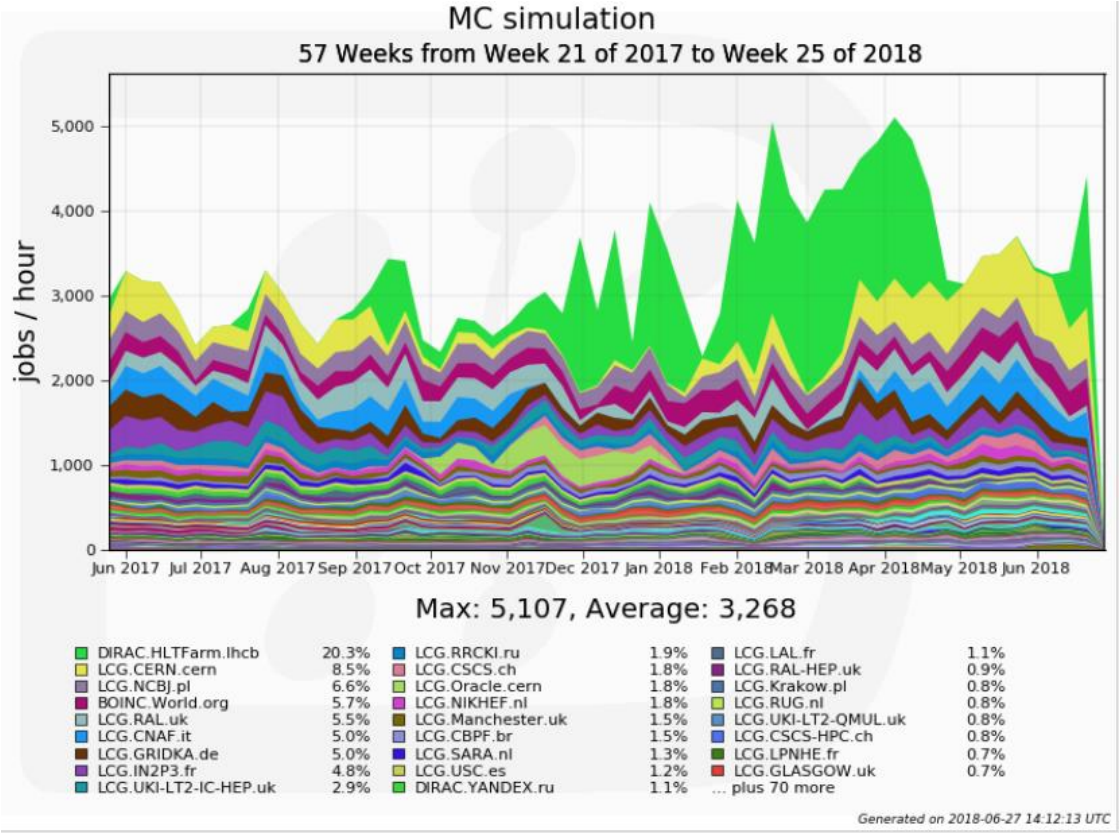
HLTFarm provides more CPU to LHCb than biggest T1

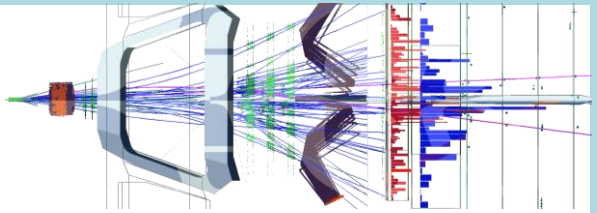






Monte Carlo production during one year





Conclusion

- Simultaneous usage is possible due to the fact :
  - Same environment for data taking and Monte Carlo
  - Same handling of the LHCb software with CVMFS
  - Fine grain configuration with WinCC OA to handle the nodes
- It has been running successfully for a while now
- It maximizes the HLTFarm usage
- HLTFarm is now only idle when there's some maintenance operations needed
- 20% of 10 Billion events of Monte Carlo have been simulated on the HLT Farm over the last year