

LHCb Run3 computing model

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LHCb is one of the four high energy physics experiments at the Large Hadron Collider at CERN, Switzerland. During the second long technical break of the LHC (LS2) that took place from 2018 to 2022, LHCb underwent major upgrades. These upgrades concern not only the actual detector, but also the computing model driving the physics analysis.

The big challenge for the new computing model of Run 3 will be the increased throughput from the upgraded detector by a factor 30, without corresponding jump in the offline computing resources. Full software trigger and selective persistency allow to mitigate this factor, nevertheless we have to scale from 0.65 GB/s (Run2) to 10GB/s (Run3).

We reviewed our data management strategies by favoring LAN transfers over WAN copies, and tailoring our workflows for a faster distribution and eviction from the experiment site. Large cross experiment scale tests were performed during LS2 in order to validate our new approach, and ensure that both our software and the infrastructure can sustain the load.

The way we process data to extract relevant physics figures also had to be considered. This impacts the centralized productions as well as the way physicists perform their analysis on a day to day basis. We make extensive use of the Turbo model, already implemented in Run 2, to reduce the computing and storage needs. The offline reconstruction has been replaced by an online reconstruction, saving a lot of CPU time spent on the grid. Finally, Analysis Productions were introduced in order to leverage the full power of the DIRAC - the WMS and DMS grid middleware used by LHCb - transformation system for the user analysis.

The Monte Carlo simulations largely dominate our CPU needs, and represent about 95% of the total CPU work on the grid. Improvements to the simulation software, as well as the introduction of fast heavily filtered simulations lead to a significantly decreased CPU work per event.

This paper presents the challenges of the upgraded LHCb computing model, the solutions we have implemented to address them, the outcome of our large scale tests, as well as the experience we draw from the 2022 commissioning year.

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