UCG Report on the TDR for the LHCb Trigger and Online upgrade


Findings

- The estimated cost is approximately CHF 11.2M, all but CHF 380K of which will be provided from the common fund, the balance will be provided by the subdetector groups.
- The proposed upgraded readout system is designed to operate at $10^{33}$ cm$^2$s$^{-1}$ luminosity, and to accept the full inelastic collision rate of 30 MHz. The 4 Tb/sec data rate will be processed by a full, open software trigger, avoiding the inevitable inefficiencies in reducing the data rate with a level-0 hardware trigger.
- The readout system consists of an event builder, timing and fast control (TFC) distribution, experiment control system (ECS) and event filter farm (EFF), to be operational in 2019. 300-meter long optical links will bring signals from the front-end electronics to the readout boards located in a data center on the surface, where the event building is accomplished with high-bandwidth cost-effective technology. The central part of the event builder consists of dedicated PC servers, each interfaced to the front-end electronics via an embedded readout unit.
- Events surviving the software High Level Trigger are stored on disk at 20 kHz, a figure estimated by reconstructing simulated events and assuming a factor 16 increase in CPU performance by 2019.
- The LHCb trigger group has performed careful R&D to make sure the performance of the various systems meets requirements in a cost-effective manner. Of particular note is the choice of fibers, where they have demonstrated that the cheaper OM 3 fibers can handle the expected 10Gb/sec rates.
- The cost estimate has been carefully compiled, and is based largely on firm quotes and tenders. Reasonable assumptions have been made for the evolution of costs of items to be procured late in the process.
- The main risks are related to the final cost of the CPU, the network technology as well as the CPU performance. These risks can be mitigated by scalability of the farm as the luminosity evolves over the years.

Comments

- We agree with the LHCC technical review that the fully software choice is well designed, provides high flexibility, and will allow the trigger to adapt quickly to evolving conditions.
- The schedule seems tight but feasible. The risk register shows the group has thoughtfully considered the issues they are likely to confront and has devised plans to mitigate them.
- The spending profile makes sense, and the labour available is adequate. Most of the physicists and engineers are employed by CERN and are already working on the current system, or have permanent positions in France or Italy.

Recommendations

- The cost estimate should be approved by the LHCC so resources can become available.
- To ensure quality and schedule the LHCC should regularly monitor progress.