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UPDATED DESIGN FOR THE ALICE CENTRAL TRIGGER

I.J. Bloodworth [1], G. Di Marzo [2], D. Evans [1], P. Jovanovic [1],
A. Jusko [3], J.B. Kinson [1], A. Kirk [1], V. Lenti [4], M. Luptak [3],
L. Sandor [3], P. Vande Vyvre [2] and O. Villalobos Baillie [1]

for the ALICE collaboration.

Abstract

The trigger and data acquisition systems in the ALICE experiment have undergone significant changes in the last year. This is (i) in response to the incorporation of new detectors, (ii) the result of the use of front-end buffering schemes in the ALICE sub-detectors and (iii) because of new more pessimistic estimates of the data volume generated by the Time Projection Chamber (TPC). In this report, we review the specification for the updated ALICE Central Trigger and examine how it might be implemented using currently available electronics components. The User Requirement Document and the Technical Specification for this system are being discussed by the ALICE collaboration.

Summary

The original trigger concept for the ALICE experiment, as described in the ALICE Technical Proposal, has undergone substantial modifications over the last year as a result of new requirements. These include the addition of new detectors, the decision by the

sub-detector groups to use front-end buffering as a means of reducing peak data flow rates to the data-acquisition system and new, more pessimistic estimates of the data volume from the TPC.

The first step towards a new description of the trigger system came in 1999 with the definition of the signal sequence for communication between the Central Trigger and the sub-detectors. Since then, a much more detailed description of the logical operation of the trigger system has been prepared. Triggers are defined in terms of trigger "classes", the function of which can be explained with a few examples. A trigger class is identified by a given pattern of trigger inputs and specified that, if it is activated, a trigger should be sent to a specified set of sub-detectors.

The trigger system in ALICE includes a provision for past-future protection for each sub-detector, to avoid event pile-up. Each sub-detector has a specific time window inside which past-future protection should be applied. Past-future protection can be applied uniformly to a trigger class, since the failure of any detector in a class invalidates the whole class.

The ALICE trigger is based on three trigger levels: L0, L1 and L2. The L0 trigger is the earliest, and is issued so as to arrive at the front-end electronics for each sub-detector at the latest 1.2 microseconds after the interaction has taken place. The latency is fixed. It is sent by the quickest possible method, namely a dedicated coaxial cable. The L1 and L2 decisions are sent using the RD-12 TTC system; L1 uses channel "A", again with a fixed latency and L2 is sent as a broadcast using channel "B". The normal operation of the TTC allows for the transmission of a trigger number following a channel "A" trigger pulse. In ALICE, this is set to be the orbit number and the bunch crossing number, in order to have an event identifier which is common for all sub-detectors.

Calibration triggers are also being considered. In most cases, calibrations which cannot be performed outside normal physics runs must nonetheless take place when there can be no collision. The simplest way to ensure this is to schedule them to take place in the large gap in the LHC bunch structure, when no collisions take place. Calibration requests can be made, which define a special trigger class, typically consisting of just one detector, and the triggers can be flagged so as to allow the front-end electronics to perform special tasks, e.g. to suspend zero suppression. The method for communicating a calibration request to the Central Trigger is under discussion.