

Timing in the ALICE trigger system

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In this paper we discuss trigger signals synchronisation and trigger input alignment in the ALICE trigger system.

The synchronisation procedure adjusts the phase of the input signals with respect to the local Bunch Crossing (BC) clock and, indirectly, with respect to the LHC bunch crossing time.

Alignment assures that the trigger signals originating from the same bunch crossing reach the processor logic in the same clock cycle. It is achieved by delaying signals by an appropriate number of full clock periods.

We discuss the procedure which will allow us to find alignment delays during the system configuration, and to monitor them during the data taking.

Summary

This presentation will deal with the synchronisation and alignment of the trigger signals in the ALICE trigger system.

Synchronisation adjusts the phase of the input signals with respect to the local Bunch Crossing (BC) clock and, indirectly, with respect to the LHC bunch crossing time. (The synchronisation delays are within one clock period: 0-25 ns.)

Synchronisation is necessary at two points of the Alice trigger system. The phases of trigger inputs relative to the Central Trigger Processor (CTP) BC clock and the Local Trigger Unit (LTU) inputs relative to the LTU BC clock are to be adjusted.

The system provides for an automatic measurement of the phase shift of all trigger inputs relative to the CTP clock and the phase of the LTU inputs relative to the local LTU clock. In both cases, following the measurement, a programmable hardware option is used to adjust the phase of the signals appropriately.

Alignment assures that trigger signals originating from the same bunch crossing reach the processor logic in the same clock cycle. It is achieved by delaying signals by an appropriate number of full clock periods.

Two ways of automatic alignment are discussed. The first is based on the activity plot of the LHC beam structure for different trigger inputs; the other procedure is based on a correlation analysis of different trigger inputs.

While the synchronisation is a fully internal procedure of the trigger system, alignment relies on the presence of external physics signals.

The feasibility of the method is evaluated in three different cases:

- without a beam (cosmic trigger),
- with one beam (beam gas interaction)
- and with both beams.

The efficiency of these procedures depends on the amount of data collected for the analysis.

There are two different ways of collecting the data for the alignment analysis:

- the data recorded through the ALICE data acquisition system (DAQ alignment data),
 - the data recorded directly in the CTP (CTP alignment data).
- The CTP alignment data can be collected by the CTP alone; independently of

the data acquisition system, because of the presence of a local memory (snapshot memory) on each CTP board.

We shall present an estimate of the time necessary to produce reliable alignment delays in different circumstances (cosmic trigger, beam gas interaction and beam-beam interaction) and using different collecting methods (DAQ or CTP data).

Finally a procedure for setting the synchronisation parameters and the alignment delays will be proposed.

In addition a possible strategy for monitoring the synchronisation and alignment will be presented.

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