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Precision Clock Distribution studies for timing in phase II upgrade of the CMS experiment

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Due to challenging conditions of the HL-LHC, the CMS detectors are undergoing a system-wide upgrade, and specifically the complete redesign of the end cap sub-detectors.
To reach the aimed resolution of 30 ps RMS on events timing information, a precision clock distribution system providing a readout clock with a sub 15 ps RMS jitter is necessary.
In this talk, a detailed study on the current technologies as well as an extensive discussion of the R&D dedicated to the low-jitter clock distribution studies are presented.

Summary

The CMS detectors are undergoing a system-wide upgrade in order to extend the physics reach, and minimize possible performance degradation due to challenging conditions of the HL-LHC. The aimed resolution of 30 ps RMS on events timing information is planned to be reached through the upgrade of the whole experiment, and specifically the complete redesign of the end cap sub-detector with a new high granularity calorimeter architecture. This new design including two different timing precision detectors will improve the vertex reconstruction and hence will help to mitigate the effects of high pile-up conditions on physics performances. In order to achieve such a sensitivity, a precision clock distribution system providing a readout clock with a sub 15 ps RMS jitter is necessary. In this talk, a detailed study and tests of the current technologies as well as an extensive discussion of the R&D dedicated to the low-jitter clock distribution studies are presented. The results are compared with respect to the channel-to-channel deviations and clock source references, and are simulated as an input to the physics performance studies. Architectural differences and implementation challenges between two possible clock distribution layouts for the upgraded CMS detectors are discussed.

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