Contribution ID: **52**

Type: **Oral**

A Precision Pure Clock Distribution System

Tuesday, 3 September 2019 14:50 (25 minutes)

We will describe a pure clock distribution system, built with discrete RF components, that we have used to demonstrate the precision that separate clocks generated from a single source can be distributed within a large detector. Clock signals were distributed directly without any encoding or clock cleaners (PLLs) through parallel 90m optical bers to front-end emulators. The phase noise measured between two 160 MHz clocks was 0.210 ps/1.0 MHz, integrating between 0.01 Hz and 1 MHz. We will discuss the system, the tests made and the steps we are taking to monitor the clock stability at the point of distribution.

Summary

As precision particle timing becomes a critical component of the design of modern high energy physics experiments the need for precise clocks distributed across the detector with low jitter between them becomes very important. The figure of merit in an experiment for a clock distribution
system is not the quality of an individual clock, which can be achieved with one or more PLLs in
the chain, but the stability between two separate clocks. This is because the relevant measurement is the time difference between two or more signals from different parts of the detector, which may be separated by tens of meters.

To investigate this question, we have built and tested a stand-alone pure-clock distribution network to quantify what can be achieved using modern discrete RF integrated circuits. The system consisted a master clock that was distributed to two parallel chains each with with multiple levels of fan-out, conversion from electrical to optical signals, transmission on 90m optical multi-mode fibers and conversion back to an electrical signal to emulate the real needs of an experiment. Using the clock from one arm as the reference clock and measuring the clock signal in the second arm, we measured a phase noise of 0.210 ps/1.0 MHz, integrating between 0.01 Hz and 1 MHz, and the time interval error measured with a high-performance oscilloscope scope was < 2ps. In this talk we will discuss the design and testing of the system and steps we are taking to demonstrate that it is feasible to demonstrate such a high precision used in an experiment.

Primary authors: RUSACK, Roger (University of Minnesota (US)); SAHIN, Mehmet Ozgur (Université Paris-Saclay (FR)); BESANCON, Marc (Université Paris-Saclay (FR)); BAUSSON, Pierre-Anne (Université Paris-Saclay (FR)); LOUKAS, Nikitas (University of Notre Dame (US)); FRAHM, Erich (University of Minnesota); SARADHY, Rohith (University of Minnesota (US))

Presenter: RUSACK, Roger (University of Minnesota (US))

Session Classification: Optoelectronics and Links

Track Classification: Optoelectronics and Links