

# LHC Machine Timing Distribution for the Experiments

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## Abstract

At the LHC the 40,079 MHz bunch crossing clock and 11,246 kHz machine orbit signal must be distributed from the Preveissin Control Room (PCR) to the TTC systems of the 4 LHC experiments, to the test beam facilities in the West and North areas and to beam instrumentation around the ring.

To achieve this, a single high-power laser transmitter with optical fanout to all the destinations has been installed at the PCR. A standard TTC machine interface (TTCmi) has been developed which receives the signals and can deliver very low jitter timing signals to LHC experiment TTC distribution systems with multiple trigger partitions.

## I. INTRODUCTION

The timing, trigger and control (TTC) distribution systems [1] to be installed at the LHC experiments must be synchronized with the bunch crossings in the machine and the orbit of the circulating beams. In collaboration with CERN SL Division HRF and CO Groups, RD12 [2] has implemented a system which allows the timing signals to be broadcast with the required precision from the Preveissin Control Room (PCR) to the experimental areas over optical fibres.

The system has first been used for broadcasting the timing for the LHC-structured extracted beams which were provided by the SPS for test purposes in May 2000. For this special run, the signals were transmitted to the X5 and X7 test beam areas in the West Hall and H2, H4 and H8 in the North Hall. Satisfactory results were achieved by the ATLAS, CMS and LHCb teams running in these areas [3].

## II. ARCHITECTURE

The overall architecture of the timing distribution system is indicated in the simplified block diagram Fig. 1. The 40,079 MHz bunch clock, 11,246 kHz (pseudo-) LHC orbit signal and 43,375 kHz SPS orbit signal generated by the synthesizers in the BA3 Faraday Cage are transmitted to the PCR by low-loss coaxial cable links with galvanic isolation.

At the PCR, a PLL with low-noise VCXO is used to reduce the jitter of the received bunch clock to about 7 ps rms and the clock and selected orbit signal are biphasic

mark encoded. The encoded signal modulates a high-power 1310 nm laser diode, the output of which is fanned out by a 1x32 passive optical tree coupler and broadcast over a singlemode optical fibre distribution network.

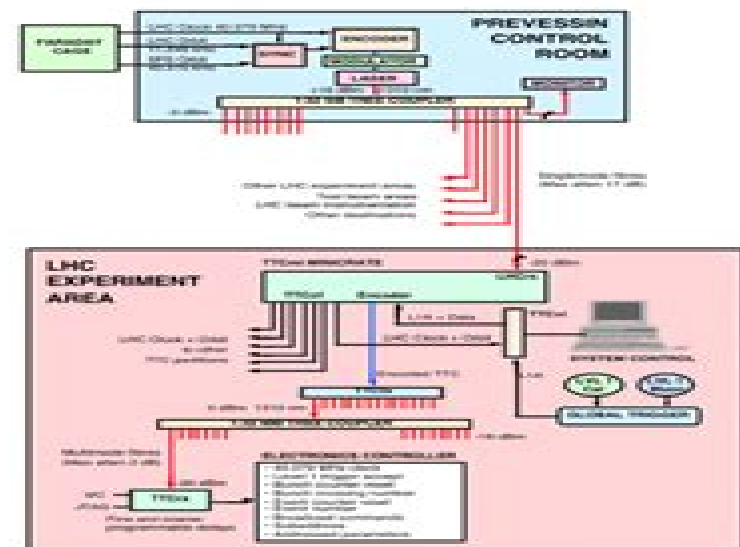


Figure 1: Overall block diagram of TTC distribution

As the experimental areas, the optical signals are received by a TTC machine interface (TTCmi) which monitors and decodes them, cleans up the bunch clock and adjusts the global phase of the orbit signal. The TTCmi then distributes the timing signals to up to 40 local TTC distribution systems for the different trigger partitions of the experiment.

## III. DISTRIBUTION FIBRE

Preliminary tests were carried out over singlemode and multimode fibre loops which were installed between the PCR and Building 4. Although the line of sight distance

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