The optical Synchronization and Link Board oSLB

Jose Carlos R. Da Silva[1], J.Varela [1,2] P.Parracho [1] for the CMS ECAL Group
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Introduction:

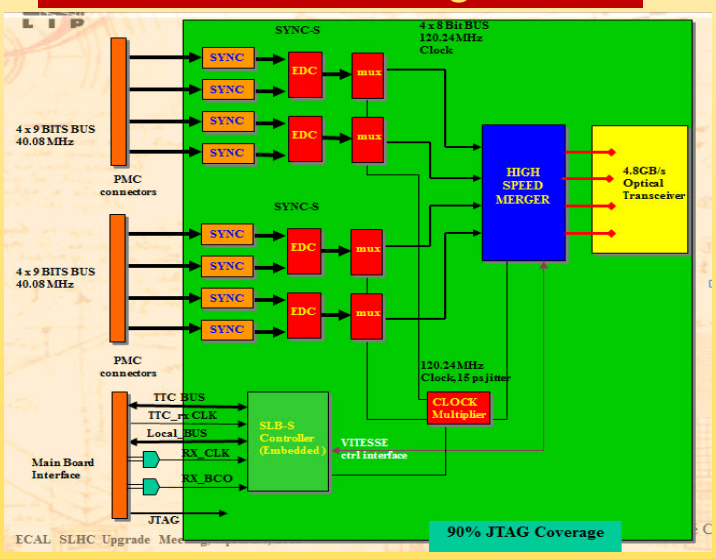
The calorimeter trigger of the Compact Muon Solenoid experiment at the Large Hadron Collider (LHC) uses a synchronization method implemented in the Synchronization and Link Board (SLB).
The SLB functionality was implemented in a mezzanine board that allows the synchronization of electromagnetic and hadronic trigger primitives at the LHC frequency (40.08 MHz) and its transmission to the Regional Calorimeter Trigger.

The new generation of the Calorimeter Trigger boards requires optical links operating at a rate of 4.8Gb/s.
To allow the development of a new trigger system in parallel with the current trigger system, the SLBs have to be modified to an optical version (oSLB) and send the same trigger primitives to both destinations.
The design options for the optical version of the oSLB as well the technological choices are presented.

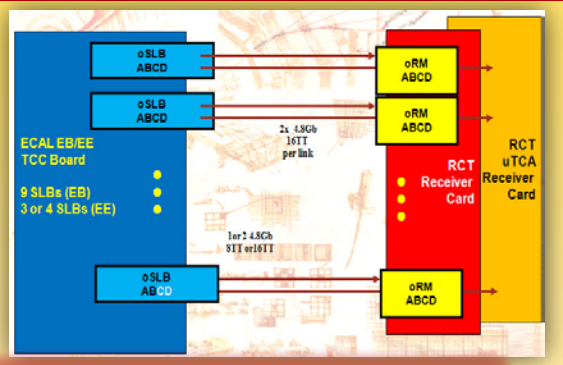
oSLB Specifications:

- Receives 9 bit data @ 40 MHz /per Trigger Tower (TT)
- Each oSLB receives the data from 8 TT from the main trigger board
- Aligns the Trigger Data using the LHC Orbit bunch structure to determine the BX position using internal histograms
- FIFO stage to compensate fiber length differences and deserialisers lock delays to guarantee the alignment of data sent to the RCT from both ECAL and HCAL.
- 2 TT data merging + Hamming code prior to send it over the high speed link
- 2 High speed links Outputs (up to 6.125 Gbps) using a Xilinx Kintex 7 device.
- Uses the VTTX dual TX optical module (CERN)

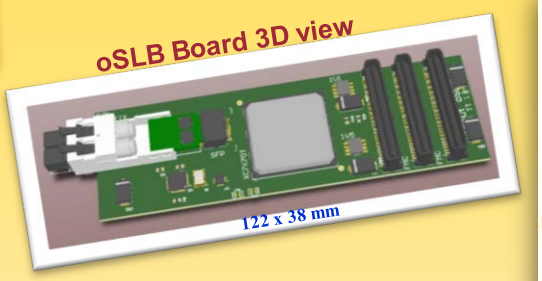
oSLB Block Diagram



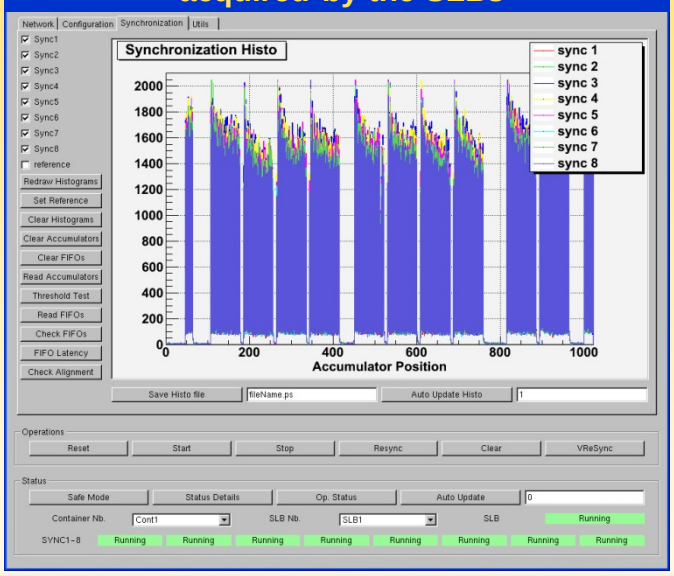
ECAL Upgrade layout with oSLBs



oSLB Board 3D view

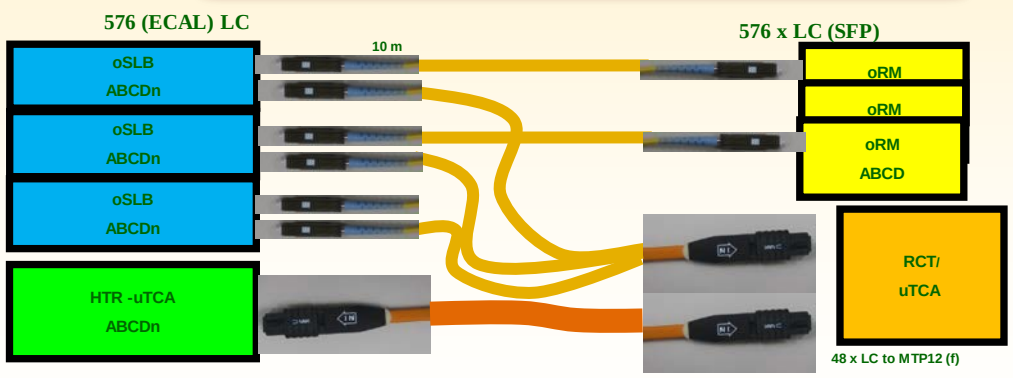


LHC 1380 Bunch Histogram acquired by the SLBs



oSLB and upgrade:

- ECAL will produce 576 oSLBs + spares
- Making use of the dual transmitters the oSLB sends the Trigger Data to the "old" Trigger system and a copy to the "new" trigger system (upper picture). This allow simplified (point to point) optical connections for the upgrade phase (bottom picture)



Alignment of the Trigger Primitives :

- Using the LHC Orbit signal as a reference, we can align and monitor the stability of the Trigger Primitives, in both ECAL and HCAL, using internal Histograms. The histogram is build using the Trigger Primitives data at the input of the SLB. Any fluctuation of the clock system or in the orbit reference makes the histogram different from the LHC structure reference and an error report is created.