Request for Comments: Specification for an AIDA TLU

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Following discussions at LLR[?, ?], DESY[?, ?] and CERN[?] it seems probable that the synchronization and timing needs of the TimePix, CALICE, ATLAS, CMS and MAPS communities within the AIDA collaboration can be met by a common hardware development. This would have the benefit of sharing hardware, firmware and DAQ-Software effort.

This document set out a specification for an AIDA TLU as a request for comments. Note that the specifications are derived from my understanding of the requirements of different groups and not from any specific TLU hardware restrictions. Please comment if the suggested specifications do not fulfill your requiremenets.

1 Introduction

The TLU provides timing and synchronization signals to beam-test readout hardware. It can either provide or accept a system clock. It provides triggers to systems that need them. It accepts busy signals from systems that provide them. It accepts triggers from an external source, such as beam-scintillators and provides a time-stamp of incoming signals.

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2 Hardware Interfaces

The TLU is normally under the control of the central DAQ software. It can be configured, controlled and the time-stamp information read-out by the central DAQ.

2.1 CALICE

Clock(5MHz), Trigger , Busy, Clock(50MHz). Trigger and Busy signals are Manchester(Phase) encoded accordinng to IEEE 802.3 to maintain DC-Balance. Matching between Calice and beam-telescope verified by matching timestamps between TLU and CALICE readout within a combined event. Integration with CALICE CCC system.

2.2 TimePix

TimePix3. Timestamping. No trigger. Distribute clock and optional synchronization signal. Event matching done via timestamp. This means that as long as there is no upset in the timestamp coiunters missing triigers are not an issue.

2.3 LHC

Either use EUDET-Style signal definitions or Calice-style interface (phase encoding is optional). Depending on requirements.

2.4 Existing EUDAQ Users

Keep compatibility with EUDAQ TLU.[**?**]

3 Integration Methods

3.1 CALICE

Various options. One possibility[**?**] control Calice run control from EUDAQ. Write separate files. Combine offline. Purpose: Mainly for system integration tests and proof of concept.

3.2 TPC

Integration of XXX , YYYY system almost completed under EUDAQ programme[**?**] , martin-killenberg.

3.3 Triggered Detectors (e.g. ATLAS, CMS Pixels)

As in EUDET. Beam-telescope and DUT synchronized by TLU hardware signasl. DUT data written either via an EUDAQ producer, or by writing telescope and DUT data to separate files and comdining offline.

3.4 TimePix

Synchronize TimePix and TLU timestamp counter via common system clock. Provide DUT with triggers if needed. Write DUT and TimePix data to separate files and combine offline. One possible refinement[?] is that the DUT can be "EUDAQ" compatible. Then only one data combiner is needed - TimePix with EUDAQ.

4 Specifications

Parameter	Value
Maximum master clock frequency, F_{master}	80MHz
Master clock jitter	To Be Decided.[1]
Timestamp precision	1 ns
Minimum pulse width (time above threshold)	5 ns
Latency	$<$ XXX cycles [2]
Maximum instantanous trigger rate [3]	F_{master}
Maximum sustained trigger rate	1 MHz

5 High Rate Tests

LHC sensors need 400MHz/cm^2 for pile-up tests. The TLU will not ba able to cope with this rate of triggers except by using very small area scintillator. In addition, even if the TLU could cope the MAPS telescope sensors would not. However, it has been pointed out[?] that it would still be possible to conduct efficiency studies by placing the telescope and DUT in a moderate rate beam and then illuminating the DUT with a high flux of radiation from either a radioactive source or an X-ray generator. That is to say, use the same approach as the Gamma Irradiation Facility[?] at CERN.