Data Acquisition systems for E896 at the AGS

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We have developed a Fastbus/VME based data acquisition system for acquiring data from the 100-plane drift chamber of AGS experiment E896. A custom interface communicates between the VME and Fastbus, while LeCroy ECL auxiliary cards transmit the event data from the Fastbus to VME dual access memories. The event size is typically 10 kBytes, and the system can write to magnetic tape over 1000 events per AGS spill ($\approx$ 4 s). Another data acquisition system serves for the silicon drift detector array (SDDA) of E896. This system is based on prototype electronics developed for the STAR Silicon Vertex Tracker system and serves as a testing ground for STAR custom hardware. The SDDA system features an HP Gigalink to transmit data from the experimental area to the counting house.

Key words: data acquisition systems, event building

1 Introduction

Experiment E896 searches for short-lived composite strange matter (in particular the H_0 di-baryon) and investigates hyperon production in 11.6 A GeV/c Au-Au Collisions. The experiment features a distributed drift chamber (DDC), a scintillator hodoscope neutron detector (the Multi-Functional Neutron Spectrometer, MUFFINS), three scintillator Time-of-Flight walls (TOF), and a silicon drift detector array (SDDA).

The experiment is divided logically into two almost independent detector systems, and each has its own data acquisition (DAQ) system. The first DAQ reads out and archives data from the DDC, all beam counters, MUFFINS, and the TOF walls. The second DAQ reads and archives data from the SDDA; it is coupled to the first DAQ mainly through a common trigger system and event tagging scheme.

2 The DDC, TOF, and MUFFINS Data Acquisition System

Fig. 1 shows the DAQ system for the DDC, TOF and MUFFINS detectors. The DDC generates the bulk of the data volume. The design is driven by the requirement to read out approximately 8000 drift chamber electronics channels and to use existing Fastbus electronics. This is done with 84 multi-hit Fastbus TDC modules (LeCroy 1879), distributed over 4 Fastbus crates. Two other Fastbus crates contain Fastbus TDC (LeCroy 1875A) and ADC (LeCroy 1885F) modules for readout of TOF and MUFFINS electronics. The data in each Fastbus crate is read out via the LeCroy 1821 Segment Manager/Interface (SM/I). The SM/I contains a fast sequencer and has the capability to make the data available to several flavors of "Personality Card" on its auxiliary connector. The programming of the SM/I is done via a custom interface using RS485 long distance drivers [1] using a custom assembly language developed for the SM/I [2]. The LeCroy 1821/ECL personality card transmits the data via 32 differential ECL data line pairs, plus an ECL strobe line pair, over 150 feet to the counting house where they connect to ECL/VME dual access memory boards (LeCroy 1190). Each Fastbus crate connects to two 1190 memory boards, housed in separate VME crates. This allows the data for consecutive events to be latched in a "ping-pong" fashion in alternate crates, thus effectively reducing the data rate by a factor of 2 compared to the rate if only one VME crate were used. Data in each VME crate is buffered in VME memory and then archived to an Exabyte Mammoth running at a rate in excess of 3 MB/s.

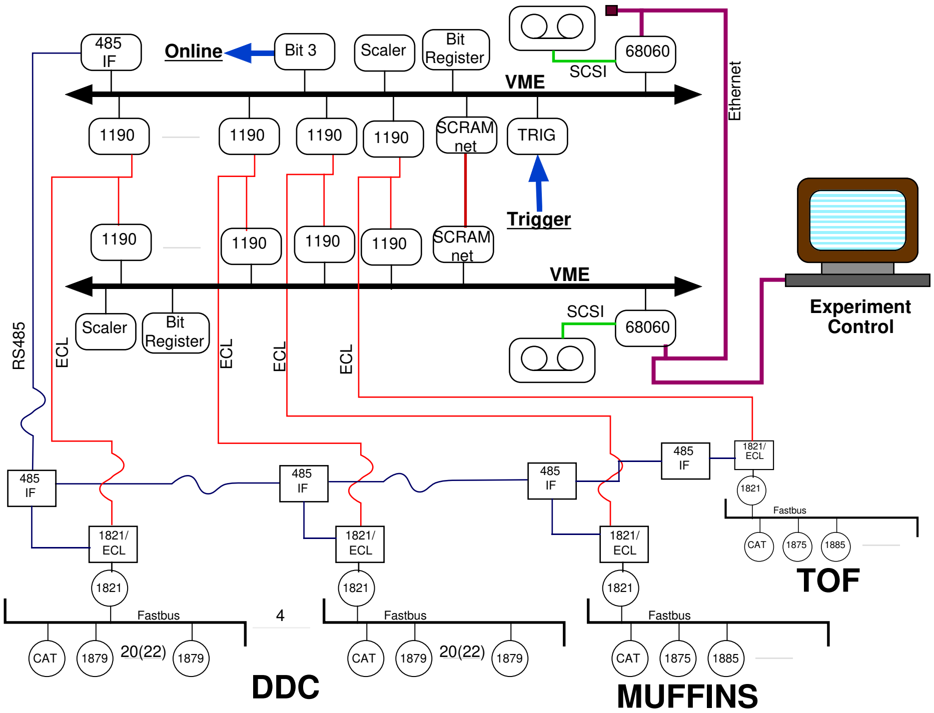

Fig. 1. The DDC, TOF, and MUFFINS Data Acquisition System

Communication between the two VME crates' CPU's is accomplished via a reflective memory interface (Systran's SCRAMnet). This interface also connects the two DAQs of E896 by communicating event information between the two systems. This architecture is capable of recording about 1000 events per AGS spill (about 1 s of beam with a 2 s pause). During the 1996/97 beam time the measured performance in ping-pong mode was about 800 events at about 33% dead time (the rate was beam limited when an almost central collision was required by the trigger system).

3 The SDDA Data Acquisition System

The SDDA DAQ system is shown in Fig. 2. The design is guided by the desire to use and test many of the components under development for the STAR Silicon Vertex Detector (SVT) since both the SDDA and SVT use the same silicon drift detectors (SDDs). The E896 SDDA DAQ is essentially the same as the DAQ system to be used in the STAR SVT system test, except that it is expanded to provide for the appropriate amount of SDD channels. The basic system, which accommodates 9 SDDs, consists of the readout (RDO) system currently being developed for STAR, a VME receiver (STAR DAQ prototype) [connected to the readout system via optical fibers], and a trigger/clock distribution board (TCD) to interface to the trigger system. The RDO is connected via an optical fiber to an optical receiver card – the "ROSIE" card developed for STAR as a prototype of the receiver cards for DAQ. Each ROSIE is hosted by a VME card (Cyclone CVME964) containing an Intel 80960 processor which assumes the role of one of the processors of the STAR receiver cards. In E896 these processors perform zero suppression on the data. From simulations we expect only about 1% of these data to be relevant for off-line analysis.

During winter 1996/97 beam time the SDDA DAQ was used to readout 2 SDD's through their associated electronics. Using an Exabyte 8500 tape drive with built in compression, the events were recorded at a rate of about 4 events per spill. The Exabyte was connected to a Motorola VME processor which received the data from the Cyclone processor over the VME bus. The Motorola processor served as the interface to run control and online monitoring. In addition, a CAMAC system connected to the VME system feeds beam counter and other information into the SDDA data stream, so that SDDA data can

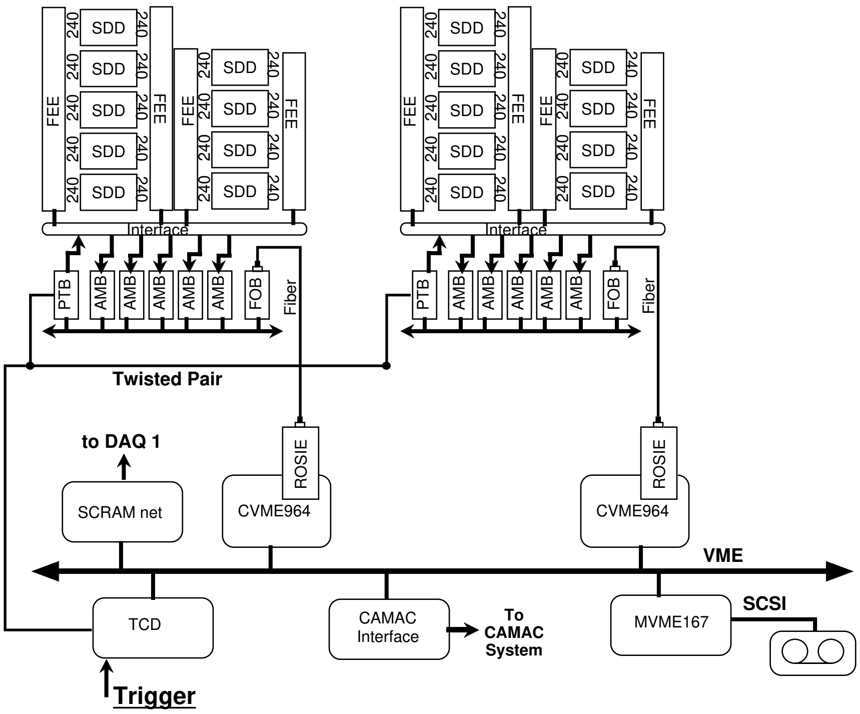

Fig. 2. The SDDA Data Acquisition System

be analyzed independently of the data from the DDC DAQ. Finally, the event number from the DDC DAQ is transmitted over SCRAMnet to another SCRAMnet module located in the SDDA DAQ VME crate in order to tag events in both DAQ systems with synchronized event and run numbers (both DAQs used the same trigger system so that there were no events in the SDDA DAQ that didn't have a corresponding event in the DDC DAQ).

Acknowledgement

This work was supported in part by the U.S. Department of Energy and The Robert A. Welch Foundation.

References

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