The Prisma-Clara Data Acquisition System

M. Bellato[2], L.Berti[1], M. Biasotto[1], M. Gulmini[1], A. Latina[1], G. Maron[1], V. Pucknell[3], N. Toniolo[1], L. Zangrando[1]

[1] INFN, Laboratori Nazionali di Legnaro, [2] Dipartimento di Fisica and INFN, Padova, [3] CCLRC, Daresbury Laboratory, UK

I. INTRODUCTION

In the middle of October is started in LNL the commissioning of a new apparatus that consists in a coupling of an array of Clover detectors (CLARA) based on the composite Euroball Clover [1][2], with the PRISMA spectrometer [3][4], a large acceptance magnetic spectrometer for heavy ions.

The Data Acquisition system is required to be able to collect the data generated by event rates up to 20 KHz. The corresponding raw data rate will depend on the particular experiment but data rates up to 4Mbytes/sec and about 200 electronic channels are required to be handled by the system.

To combine the two sub-systems and to accomplish the requirements, a DAQ design was developed on the base of event synchronization with a time stamp technique.

II. THE DATA ACQUISITION SYSTEM

The Prisma-Clara Data Acquisition System structure is shown in fig. 1.

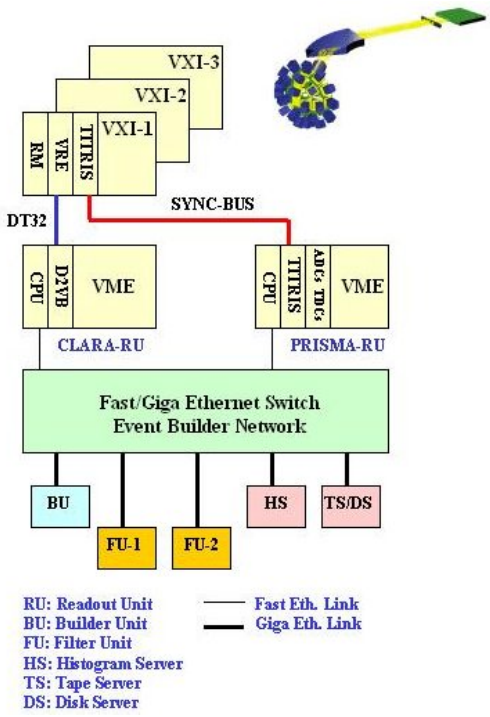

***Fig.1**: The Prisma-Clara Data Acquisition System*

The main components are the Readout Unit (RU), the Builder Unit (BU) and the Filter Unit (FU).

The purpose of the Readout Unit is to read events from the front-end electronic, buffer them locally and serve them to the Builder Unit.

The Prisma RU is a Motorola PowerPC board (MVME-2400 featuring the MPC750 microprocessor) housed in a VME crate in order to access the front-end ADCs (Caen V785 peak sensing 32 channels), TDCs (Caen V775 32 channels) and a Scaler (Caen V830 32 channels).

Advanced setting and readout modes as Multicast (MCST) and Chained Block Transfer (CBLT) operations allow best performances accessing several boards at the same time.

A generic I/O PMC module [5] programmed to handle an interrupt source (the trigger) and two synchronization lines (system busy and trigger veto) manages the trigger.

In the Clara system, the Clover VXI digitizers [6] from Euroball have been used in the front-end electronics, housed in three VXI crates.

The data are readout by DSP modules and sent on the parallel DT32 bus to the D2VB [7] memory in a VME crate, which is read by the Clara RU, a Motorola PowerPC processor board (MVME-2400).

The two sub-systems run as independent DAQ systems and produce their local dead time during readout. Each of them is equipped and synchronized with a time stamp module (TITRIS) [8], designed at GSI and already used in the RISING (*R*are *IS*otope *I*nvestigation at *G*SI) experiment Data Acquisition System.

The Titris module runs with a clock speed of 50MHz and delivers 48 bit time stamps with a resolution of 20 ns.

After setup, whenever a proper signal (experiment trigger) is sent to the input of an individual module, its time is latched to the time stamp registers. The module has no multi-event capability.

Although hardware identical, one arbitrary module must be configured as master, all others as slave.

All Titris modules are connected with a synchronization bus capable of covering distances of at least 50m between the sub-systems where required. Via this bus the master module sends synchronization pulses to all slaves to keep all modules on the same time base.

The data flow coming from the two RUs are sent to the Builder-Unit via the switched network using a PUSH technique (data are sent asynchronously to the Builder processor).

The Builder-Unit plays two crucial tasks in the Data

Acquisition System: it provides the merge function and acts as events distributor for the processors of the analysis farm (Filter Units).

All event fragments from the input streams are checked (valid time stamp, basic consistency checks, etc.), merged according to their time stamp value into "physics events" thus reformatted into a single output stream.

Each Filter-Unit of the back end system can establish on the fly a connection to the Builder receiving complete events, compute them according to the user needs, produce histograms and store the filtered events on tapes or disks.

At the present the DAQ is running with Prisma-RU implemented under the real time operating system vxWorks, while the Clara-RU is running under LynxOS.

Builder Unit, Filter Units and computing services (Histogram Server, Tape/Disk Server) are based on the Linux operating system and run on commodity dual processors PCs connected to the network through a Gbit Ethernet link.

The software package that provides the generic behavior and the communication protocols for the Prisma-RU and the Builder-Unit is XDAQ [9][10]. It's a software environment designed (by the CMS TriDAS group at CERN) to match the diverse requirements of data acquisition application scenarios of the CMS, which can be adapted to almost any kind of experiment.

The Fus are based on the Euroball NEO++ software (Nuclear Experiment Oriented). NEO++, originally developed in C++ on Solaris OS, has been ported on Linux OS, and allows complex user defined online analysis.

The complete system is controlled and monitored by MIDAS (*M*ultiple *I*nstance *D*ata *A*cquisition *S*ystem) Graphical User Interface (GUI), a highly modular software package based on TCL/TK, already used for Euroball and integrated with the XML/SOAP [11] support for the control of the XDAQ nodes.

III. STATUS

The data acquisition system has been successfully tested during the commissioning of the apparatus and is ready for the experiments.

Some performance tests must be performed.

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