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Multinode data acquisition and control system for the Vertex Elements of the TACTIC telescope array

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Abstract. An interrupt based multinode data acquisition and control system has been developed for the three Vertex Elements of the TACTIC telescope array. The paper describes the salient design features of the hardware and software of the system.

1. Introduction

The TACTIC telescope is a compact array of 4 atmospheric Cerenkov telescopes positioned at the centroid and the vertices of an equilateral triangle of 20m side (Tickoo et al. 1999). While the centrally located 349-pixel Imaging Element has been in operation for the last 3 years, the 3 Vertex Elements (VE) have been commissioned recently. During source observations the 3 VE, each with a 9.5 m^2 light collection area, track a designated celestial object synchronously. Each of the 3 VE deploys a photomultiplier tube based 58-pixel duplex camera for carrying out high sensitivity polarization, spectral and temporal investigations of the recorded atmospheric Cerenkov events. The duplex camera comprises two 29-pixel sections positioned on either side of a beam splitter plate resulting in time correlated optical inputs to the corresponding pixels of the two sections. The camera uses 52 mm diameter photomultiplier tubes (pmt) for polarization studies and generation of the local triggers while 19mm diameter, visible (300 – 600 nm) and UV (160 – 350nm) pmt are used for monitoring the spectral ratio of an event. The local trigger from each element is generated as per user defined topological configuration stored in the programmable trigger generator. The individual element triggers are dynamically delayed as per their position coordinates and source zenith angle to line up the genuine 3-fold coincidences for generation of low threshold energy ($E\gamma > 0.2$ TeV) triggers which interrupt the Data Acquisition and Control System.

2. System description

As depicted in Fig. 1 the Vertex Elements Data Acquisition System (VEDAS) has been designed around a 3-node network of PCs running a real time operating system. The Master Node (N#2) has all the executable modules available on its hard disk. During system operation N#2 spawns the executable modules on the front end nodes which in turn send all the data acquired from

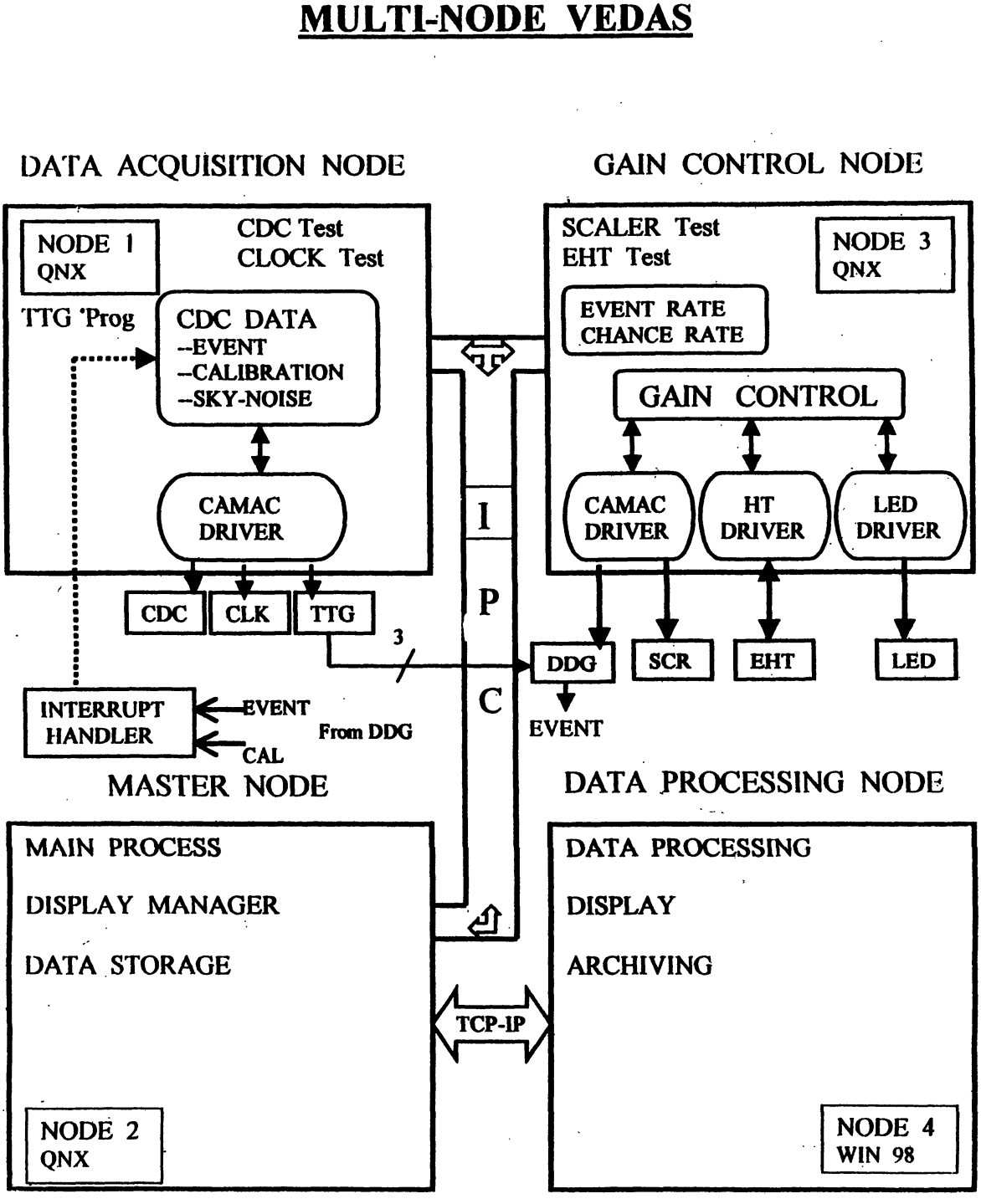

Figure 1. Block diagram representation of the multi-node Vertex Element Data Acquisition System (VEDAS) of the TACTIC telescope array.

the front end CAMAC based charge digitisers, scalers and voltage monitors back to it for storage. One of the two slave nodes, N#3 is dedicated for the control of the HV of all the 3 duplex cameras and the monitoring of their shot-noise rate at a preset interval of 2 seconds to ensure their operation in a safe mode. In the event of any pixel getting exposed to excessive incident light as a consequence of star field rotation or accidental exposure, the software takes corrective action to lower the pixel gain to a safe value in a few correction cycles each of which lasts for about 2 seconds. The other node N#1 logs the time of occurrence of an event along with the charge content of all the pixels in response to a trigger. This node also handles the generation of the elaborate data file structure and the calibration of the cameras using pulsed blue LED based light flashers.

The VEDAS runs a total of 10 concurrent processes on the 3 nodes of the network. Extensive inter process communication across the network is used to ensure stable and safe operation of the system. The master process operating on N#2 has been provided with extensive graphics support and user friendly icon driven interfaces. A Windows 98 platform is also connected to the master node over TCP-IP for on line data analysis and archiving on CDs and DAT tapes.

3. System performance

During test runs VEDAS has operated satisfactorily at sustained artificial event rates of upto 200Hz. The artificial triggers were generated by concurrently flashing the relative calibration LEDs mounted on each Vertex Element camera. On each trigger the charge content data of each of the 174 channels of the 3 Vertex Elements was acquired along with the event occurrence time with microsecond resolution. For event rates of upto 200 Hz all the events were accurately recorded. Any further increase in the event rate resulted in some events being missed by the data acquisition system. With reliable operation confirmed for event rates of upto 200 Hz the Vertex Elements of the TACTIC telescope array are poised to start source observation runs soon. During source observations it is expected to collect data at an average event rate of about 5 Hz leading to a data throughput of 10-20 MB/hr.

References

Tickoo A.K. et al., 1999, Exp. Astron., 9, 81-101