Data Acquisition at ATLAS

Ken Teh <teh@anl.gov>

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Introduction

Plans are underway to replace and modernize data acquisition for experiments at ATLAS. While the present system, the MSU/Daphne system, has served well, it is showing its age. In particular, it runs on obsolete hardware. The new system, called SCARLET, is based on commodity PCs and the widely popular Linux Operating System. It is also relatively inexpensive so many more systems can be deployed both for online and offline purposes. This write-up outlines plans for deploying SCARLET for experiments at ATLAS and hopefully addresses issues of concern to the ATLAS user.

Networking

The data acquisition network is a private network. It is bridged to the Internet via a NAT gateway which acts as a primitive firewall. ANL has an active cyber-security infrastructure and it was decided that these requirements were too onerous for the purposes of conducting experiments at ATLAS. By making the network private, devices located on the data acquisition network are shielded from active security scanning by the laboratory. The NAT gateway allows one-way traffic originating from the data acquisition network to reach the Internet. That is, incoming network traffic that is in response to traffic originating from the acquisition network is unimpeded. Incoming network traffic not in response to such originating traffic is blocked by the gateway. In other words, computers on the data acquisition network "see" the outside world, but the outside world cannot "see" them. Users planning to connect their own devices to the network should be aware of this fact and its limitations.

SCARLET In Brief

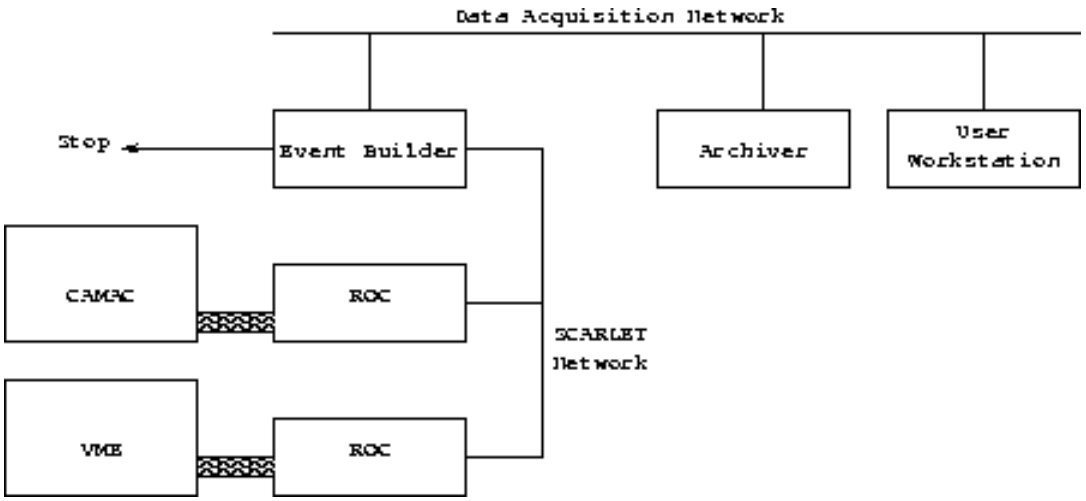
The SCARLET acquisition system is concerned solely with data acquisition. It does not include data monitoring and analysis. This decoupled approach makes it possible to use a variety of exisiting software to monitor and analyze the data collected with the system. The Physics Division has decided to use ROOT, a CERN-based data analysis software package, to monitor and analyze data collected by the SCARLET system. In other words, support will be provided for a ROOT-based back-end. However, the SCARLET system uses standard TCP/IP sockets for delivering data to a back-end, so users who prefer to use alternative software may do so. Help will be provided to users who wish to interface alternative analysis software to the SCARLET data stream.

Data Archiving

Data collected by SCARLET will be stored on disk. This is in contrast to the decades old tradition of writing data to tape. Disks have a significant performance advantage over tapes and disk arrays with terabyte capacities are reasonably affordable. Facilities, however, will be provided to copy the data to tape. The Division plans to provide a variety of drives of different tape formats such as DLT, DAT, Exabyte, VXA, AIT, etc. In addition, the disk array server will provide anonymous FTP access so users may retrieve their data across the Internet.

SCARLET Architecture

This section is provided for users who are interested in details of the SCARLET sytem. The SCARLET data acquisition system features multi-crate parallel readout, that is, crates of digitizers are read out concurrently. A setup consists of an event builder connected to one or more readout controllers (ROCs). Each readout controller reads the digitizers via some appropriate interface. At present, support for CAMAC crates is accomplished with a Wiener CC32 CAMAC controller which is connected via PCI to a PC, the readout controller. The readout controllers, in turn, are connected via Ethernet to the event builder. The readout controllers collect sub-events which are retrieved by the event builder and reassembled into the complete event. The builder buffers these events and makes them available to clients interested in reading the data stream. One such client is the archiver program which reads the data and writes them to disk. Another will be the on-line data monitoring program. The figure below shows the interconnections between the various "players" in a typical acquisition setup.



The SCARLET network is private to an event builder and its ROCs. The use of a network offers several advantanges: They are a ubiquitous standard, inexpensive, reliable and allow ROCs to be placed at a considerable distance from the event builder. Standard ethernet cabling has an limit of 100 meters. The connection between the ROC and its crate depends on the specific hardware. The Wiener CC32 CAMAC controller uses a SCSI cable which has a limit of 6 meters.

SCARLET makes generous use of standard TCP/IP for its interconnections. The only exception is UDP/IP which is used to send and receive commands and messages. UDP is a connection-less protocol which means that the SCARLET control module running on the user's workstation can be stopped without affecting the acquisition task. Control of the acquisition task can then be resumed at a later time from the same workstation or some other. Access to the on-line data stream is accomplished by creating a TCP/IP connection to the event builder. No application protocol is required. When the connection is established, the event builder will send its data stream continuously to the remote data client..

Another feature of SCARLET is dynamic linking which is used to factor hardware dependencies from the software. Hardware dependent software is written as a dynamic load library (DLL) which is loaded at run-time in order for the ROC to access its crate. Adding support for new hardware is a simple matter of writing a DLL for the specific hardware. The rest of the software remains unchanged. For example, VME readout is currently not available but can be added relatively quickly by writing an appropriate DLL for the particular VME interface.