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VMS Software for the Jorway-411 Interface*

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VMS SOFTWARE FOR THE JORWAY-411 INTERFACE

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Introduction

This reports on a Software Package to access CAMAC through the Jorway-411 Interface, for use on VAX/VMS systems. The software can be used to access parallel and/or serial CAMAC branch highways, and multiple Jorways may be connected to the VAX UNIBUS or MicroVax QBUS. The software available includes a VAX/VMS device driver for the JORWAY-411 [1] and support routines and programs that access the driver. The software is accompanied by extensive documentation.

As discussed below, several of the packages originated from other institutions and have been enhanced by the Data Acquisition Software Group at Fermilab. The software package is in widespread use at Fermilab and over 20 other sites.

The software can be run on any of the UNIBUS VAX-11 family of computers using a UNIBUS Jorway-411 to interface to CAMAC, or on a Microvax-II either interfaced to CAMAC through a Q-BUS Jorway-411, or through a Microverter and UNIBUS Jorway. The package includes facilities for performing CAMAC operations remotely. The VAX on which the user runs his or her program need not be directly connected to the Jorway. Server programs allow a VAX connected via DECNET or a PDP-11 connected via a DR11-W link[2] to be the route for accessing the CAMAC hardware.

The CAMAC_VMS software consists of the components as shown in Fig. 1.

I. CAMAC Device Driver

A VAX/VMS Device Driver, CJDRIVER, provides multi-user access to a Jorway, as well as provision for data acquisition from CAMAC - where a CAMAC LAM stimulates execution of a list of CAMAC operations. The driver incorporates the original SLAC CAMAC driver for the Jorway by Charles Granieri[3]. It provides for single word and DMA operations to be performed.

At Fermilab the following features have been added:

A Module and Crate Booking Handler.

A user may request exclusive access to one or more particular CAMAC Crates or stations within a crate. The CAMAC driver keeps lists of the crates and stations booked by each process and channel identifier. When the booking handler is installed, any CAMAC operation attempted through the normal CAMAC driver is only done if the process is allowed access to the crate and station. A very simple priority and identification scheme allows for restricted as well as exclusive access to a booked station, and for priority override of a booked module[4].

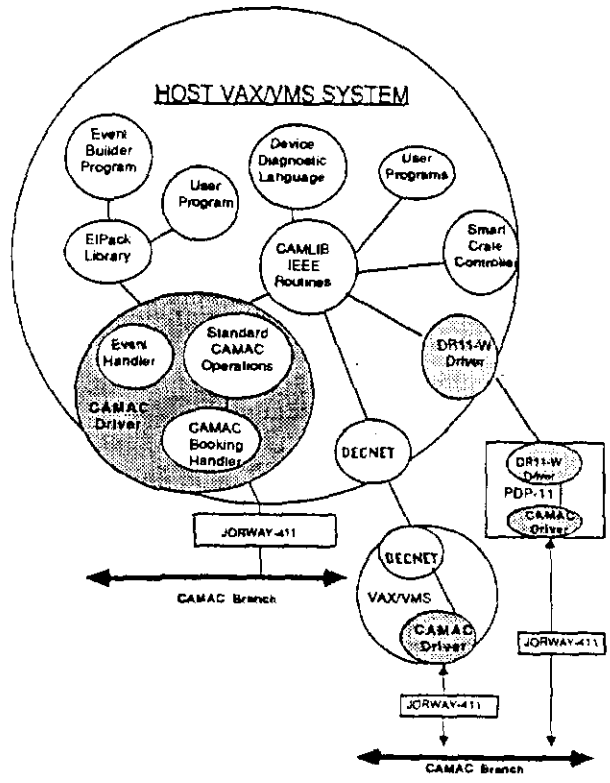

Figure 1: Overview of the CAMAC-VMS Software Product

Event Handler Module

A whole parallel piece of code has been added to the driver to provide data acquisition functions.

The Event Handler allows a program to be informed of the occurrence of a CAMAC LAM. In addition, the user may pre-declare lists of CAMAC operations to be performed on receipt of a specific CAMAC LAM or on expiration of a software timer. The user also provides a data buffer into which data read by these lists will be read. The driver stores the address of a connected list. The user then declares a data buffer to be filled by one or more executions of the list. When the CAMAC driver detects the LAM, it executes the CAMAC list and reads data into the buffer. When sufficient number of events have been read to fill the buffer, the user is informed and can access the event data.

This mechanism significantly reduces the VMS QIO and software overhead associated with the

*Operated by the URA, Inc., under contract with the U.S. DOE.

CAMAC readout. Only 2 QIOs are required to read out as many events as can fit in the declared buffer and to execute any number of CAMAC operations. Because of the specialized purpose of the Event Handler package, the lists are restricted to no-data CAMAC operations, CAMAC write operations where the data can be specified when the list is built, and read operations. No arithmetic, logical or other general programming functions are supported by the list structure.

The Event Handler allows multiple LAMs to be actively connected to different processes at any time[5].

II. Support Routine Packages

Easy user access to each part of the CAMAC driver is provided by Fortran subroutine packages.

IEEE Standard Routine Package

An implementation of the IEEE CAMAC routines[6] provides access to the original SLAC driver. All flavours of CAMAC DMA are implemented Q-STOP, Q-REPEAT and Q-SCAN. This library, CAMLIB, is an extension of that implemented by the University of Michigan.[12]

Extensions to the original package and to the IEEE specification, allow access to more than one CAMAC branch, and access to both parallel and serial branch highways, access to the Booking Handler, and extensive error reporting[7]. Further extensions provide a transparent interface to the remote CAMAC facility described below, and to the Fermilab Smart Crate Controller, described in a companion paper to this conference. The changing of a VAX/VMS logical, external to the user's program, is all that is needed to switch between the various CAMAC interfaces.

Event Handler Packages

A package of Fortran subroutines allows a user program to dynamically construct and declare the CAMAC lists. A program which uses the subroutines has been written to allow the user to construct the CAMAC lists as files of ASCII text and pass them through an interpreter before declaring them to the driver[8].

III. Remote CAMAC Functions

A program running on a VAX/VMS system may actually execute the CAMAC operations on a CAMAC branch physically connected to another VAX, connected to the user's VAX through DECNET, or on a PDP-11 running RSX-11M and connected by a DR11-W link. The PDP-11 and VAX must be running the Fermilab Connected Machines software package[9]. Server programs are provided to run on the remote VAX or RSX-11M system. Although the performance of this configuration is much slower than that for CAMAC directly connected to the users VAX, this facility has been found to be useful in installations where experiments are taking data on one or more PDP-11s, and where calibration and monitoring programs are more naturally suited for a host VAX.

IV. Application Level Programs

The software is accompanied by sample programs which exercise each feature of the CAMAC driver. The interactive, interpretive program Device Diagnostic Language[10] has been interfaced to the IEEE CAMAC routines. The Fermilab VAX data acquisition program, EVENT_BUILDER, has been interfaced to allow CAMAC data to be taken and concatenated with event data from other sources[11].

V. Timings

The timings measured depend on which VAX system is being used. On a VAX 11/780 CAMAC DMAs take between 3.5 and 5 microseconds per 16-bit word. On a Microvax II system (using either a Q-Bus Jorway-411 or a UNIBUS Jorway interfaced through a Microverter) DMA speeds of 2.5 microseconds per 16-bit word have been measured.

The QIO overhead for a normal CAMAC operation is 5 msec on a MicroVax-II and 6 msec on a VAX-11/780. The event handler overhead is about 10 usec per list operation. The QIO overhead for event readout depends significantly on the data buffer size.

Summary

Traditionally, Fermilab fixed target experiments have read their CAMAC data into PDP-11 computers. They have used the VAX software to perform calibration and monitoring tasks on the experiment. At Fermilab we have modified the Jorway-411 such that two interfaces may access (share) the same CAMAC branch. The new generation of experiments will read data from several sub-systems into a MicroVax or VAX for logging to tape. The software reported in this paper allows them to read CAMAC data directly into the data stream on such systems.

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