Development of New Data Acquisition Systems

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II. 1. Development of New Data Acquisition Systems

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Two types of data acquisition (DAQ) systems have been developed for use in experiments at CYRIC. One is a conventional CAMAC-based system but utilizing the FERA bus for improved performance and another is a VME-based system. These platforms are chosen aiming at making the most of existing properties. The considered experiments are medium in scale, typically having an event rate of a few kHz with an event length of several tens of or a hundred words. Experiments being proposed as well as the ones using the facilities recently constructed, e.g., the neutron detector system consisting of 32-set counters and the clover-type Ge-detector array with BaF Compton suppressors, are expected to be covered by these DAQ systems.

The CAMAC/FERA system utilizes a pair of memory modules (LeCroy 4303) in the double-buffer mode; the data are alternately buffered to one module via the FERA bus at a rate of 20 MB/sec while the previously buffered data in another module are transferred to the PC via the CAMAC bus at the same time, so that the slow transfer rate of CAMAC (0.5 MB/sec for TOYO CC/7700-PCI) does not become a bottle neck. The performance is summarized in Fig. 1. The buffer exchange is triggered at a preset size of data by a hand-fabricated module, which takes care of veto logic as well. LeCroy 4303 is also capable of generating LAM at buffer full but only asynchronously with event processing, thus of little use. In the VME system, a similar operation is possible by utilizing multi-functional TDC/ADC modules, CAEN V775/785/792, which incorporate buffer memories, the self-blocking logic, and even the chained block-transfer function for multiple modules. The maximum transfer rate is 26 MB/sec, which is determined by the VME-PCI interface (SBS 617). The overhead of DMA is approximately 100 μs.

Both the systems use personal computers (PC) running a free UNIX clone, Linux, as

host processors for cost-effectiveness. Such a choice is common today and there exist a number of sophisticated systems, yet the UNIDAQ[1)], which was developed for the SSC project about 10 years ago, is tentatively employed because it is reasonably versatile and has been familiar to collaborators around CYRIC. The improvement of performance has been realized by developing dedicated device drivers for CAMAC and VME interfaces. For DAQ with a 100% duty factor, which is often the case in cyclotron experiments, a quick response to interrupt is crucial. In the present systems, all the data are collected in the interrupt handler of device driver instead of accessing from user processes, thus allowing access at the highest speed of the hardware. This requires, however, editing the device driver, which is a part of the kernel, depending on the DAQ configuration and accompanies a great danger of freezing the system. For partly relieving this problem, the device drivers are separated into two layers so that the scope of user function is limited as small as possible. For the lower layer of VME device driver, vmehb-2.2.7[2)], which was originally developed at NIKHEF, is used by porting to match with Linux kernel-2.4.

References

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2) Kruszynska N., vmehb-2.2.7, VME bus Host Bridge (2000), unpublished.

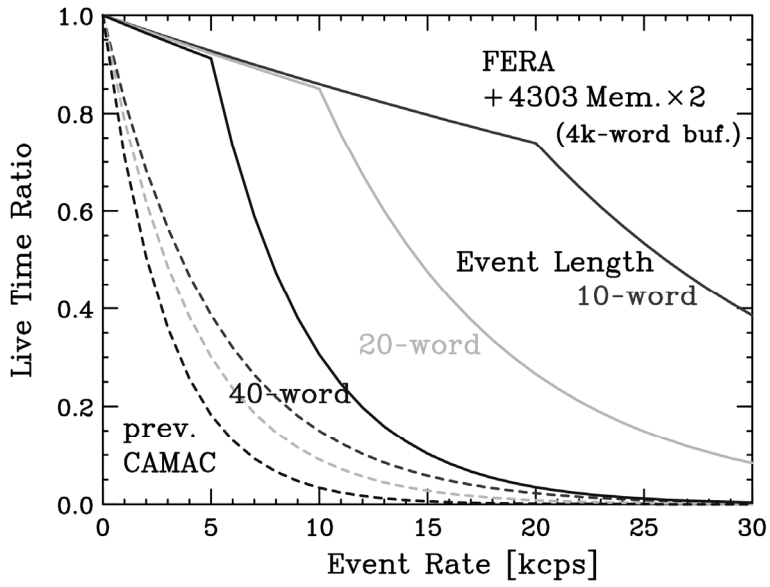

Figure 1. DAQ dead time as a function of event rate and event length is presented compared with the previous system. Practically it is reduced by a factor more than ten, though the transfer rate is not totally increased in the true sense of the word.