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Design of a Control System of the Linac for SPring-8

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Abstract

The design of a control system of the linac which is a large scale system including many unstable components like klystrons and modulators. The linac for SPring-8 requires to be operated automatically for injection to the synchrotron. Under these conditions, we chose a distributed control system architecture of a single layer net-work to simplify the protocol of the net-work between the linac, the booster synchrotron and the storage ring. A VME computer of 68030 is put in every modulator of the linac, and all control signals are gathered to the nearest VME computer. OS-9 and OS-9000 are on trial for investigation of the performances. TCP/IP is tentatively chosen as a protocol of the net-work, but we expect that MAP/MMS makes a high performance, and we are preparing a test of it.

INTRODUCTION

We decided that all hardware should be selected from ready-made machines for security of reliability, and our needs is satisfied at low cost without any customizing modules. Because this linac will be used on commercial base, reliability is the most importance for this control system. Moreover, easiness to use is necessary as a user oriented system. This linac consists of 26 pairs of a accelerator section and a klystron, so control signals mainly exist around modulators. Every signal is connected to the nearest VME computer in the modulator. 26 VME computers are connected to the flat network of one layer. Each VME computer works for a modulator, magnet power sources, vacuum pumps, RF phase control and monitors. Software of 26 VME computers are almost same, and it is easy to check whole performance of this system by a test bench of one set.

CONFIGURATION OF THE SYSTEM

A.Hardware

MVME-147s(Motorola) is selected as a CPU board, and it is set in a cage of 20 plots. Digital input/output boards are photo-isolated type, and analog input/output boards are two type of 12bit and 16bit. All signals directly come to the computer through a interface circuit of no CPU, but signals of monitors must have interface devices to establish satisfactory performances.

B.Software

The operating system is OS-9, and the language is C, and partly assembler is used. To select OS, VxWorks, VRTX, LynxOS, OS-9000 and others are check up. OS-9 is selected at the points of reliability, ability of stand alone work without development systems and suitability for bottom up build of a system. Applications and libraries will be made from practical use of object oriented programming.

STRUCTURE OF PROCESS

Every task consists of a control process, file-managers and device drivers. To get higher flexibility, all parameters are described in several parameter-files, and processes have no inner parameters.

A.Communication process

The data format of communication between processes is the same as the format of data through the net-work. If one process send a event (or a signal) to the out of one's cage through a network, the event is received by a communication process. The communication process searches the network address of the cage to which the target process belongs, and it send the event signal as a datagram to the cage. The address of machines are not fixed. The machine address resolution procedure(MAR procedure) defined machine addresses. When a searched process name belongs to a machine, the MAR process of the machine answers its address by broadcast.

B.Logging process

Most of the data sets are logged by a double buffered method. A double buffered method is combination of a ring buffer and a event buffer. The ring buffer stores continuous data of short interval, and if any troubles appear, shifting of the ring buffer is stopped to trace of the origin of the troubles. The event buffer stores log of status for long term.

C.Interlock process

Inter lock signals must be taken by hard wires without computers. But it is able to reduce the wires by a inter lock bus system. In this linac, 26 modulators are almost same, and inter lock signals are classified into different emergency

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levels. The number of hard wires is the number of the emergency levels, and each hard wire is connected in series with same emergency level signals. Inter lock process on the computer sends the detail of what kind of inter lock works to the host computer.

CONCLUSION

Conceptual design of the linac control system is almost finished, and development of the system for a test stand will be started from next June. Coding of software is started already, and now modification of network protocol is going on.

Linac Control System Diagram