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Porting Linac Application Programs to a Windowing Environment

J.M. Nonglaton, U. Raich
CERN 1211 Geneva 23 - CH

Abstract

We report our experience in porting Linac application programs written for Camac controlled hardware consoles to an X-Windows/Motif based workstation environment. Application programs acquire their parameter values from a front end computer (FEC), controlling the acceleration process, via a local area network. The timing for data acquisition and control is determined by the particle source timing.

Two server programs on the FEC for repetitive acquisition and command-response mode will be described.

The application programs on the workstations access a common parameter access server who establishes the necessary connection to the parameters on the FEC. It displays the parameter's current values and allows control through Motif widgets.

An interactive synoptics editor and its corresponding driver program allow easy generation of synoptics displays and interaction through command panels.

I. THE EXISTING SYSTEM.

The control system for our Proton Linac has been designed and implemented in the mid seventies. The system is based on a single PDP-11 minicomputer running the RSX-11 operating system. Because of the memory sizes available at that time all system software and a major part of the application programs has been written in Macro-11.

The software system consists of 3 logical parts:

- The equipment driving software: all equipment is interfaced through serial Camac. This software part contains a "central request processor" collecting all requests for Camac access and sending out Camac command in synchronism with the particle source timing.
- Software managing the operator consoles the consoles are interfaced through parallel Camac
- The application programs.

For historical reasons the Linac control system is the only accelerator control system in our division that uses PDP-11 computers. All other machines are controlled with Norsk Data equipment. The consequence of this is the impossibility to access the Linac control system from the general purpose operator consoles in the main control room (MCR), since the computer networks of the two types of systems are incompatible. The first goal for this project was therefore to give access to Linac parameters through the new workstation operator consoles.

II. THE NEW SYSTEM

The old PS control system is in a process of rejuvenation [1] according to the new common architecture for CERN accelerator [3]. In this global plan a special plan was defined for our Proton Linac. This was especially needed by the impossibility to maintain any more the equipment of the Linac consoles. It was also an opportunity to gain experience in windowing environment and in porting old style application into this environment. To achieve this halfway solution, we decided to connect the PDP11 front end computer to Ethernet network and to use Decnet communication package between these front end and the Ultrix workstation. This network software was the only one supported by the manufacturer DEC on the RSX11-M operating system of the PDP11. We therefore needed to write Decnet server for PDP11 to allow remote access from the workstation to the equipment.

III. NEW SOFTWARE WRITTEN FOR THE PDP-11

Because the Proton Linac is almost permanently running during the whole year, only a gradual switchover to the new system seems possible. We therefore decided to rewrite the major application programs under X-Windows/Motif for the workstations and leave the change of the parameter access processes to the DSC for a later date. In order to be able to operate the Linac from a workstation we identified the following software as absolutely indispensable:

- access to any single parameter for acquisition and control;
- synoptics;
- logs;
- several application programs, especially beam diagnostics.

Leaving the old consoles in the Linac control room in place and the old programs accessible, it was possible to install the new application software without interference in the operation of the accelerator. To make the parameter-access-part of the PDP-11 system available to the external world, two "server programs" on the PDP-11 had to be developed. The first one (VXS) operates in command-response mode, waiting for a command sent to it over the network. This command is translated into calls to the hardware driving software and submitted. The response is put back into a network packet and sent back to the requester. The command-response server accepts commands to acquire equipment data and status, to control equipment and to get database information like min/max values, convertion factors and the like.

The second server (SNS) gets a collection of equipment parameter names and performs continuous acquisition on these parameters. The acquisition values are periodically sent back to the requesting client program. The timing for the acquisition is given by the proton source timing which pulses at a rate of 1 Hertz.

The only network software available under RSX11-M is an incomplete implementation of DecNet, which does not allow to open more than 1 logical link to another task. Real server processes are therefore impossible. The only way to allow several tasks access to Linac parameters is to duplicate the "servers".

In addition to the "servers" described above (SNS,VXS) , which are the most important ones, a GPIB server, a CAMAC

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access server and a server for starting any PDP-11 application have been written.

IV. New Software on the Workstations

A. The knob server

In order to harmonize the user interface for parameter access of all applications programs a "knob server" has been developed on the workstation. A typical application program will register all parameters it needs to be updated regularly on SNS and allow the user to select a limited number of parameters for control. These parameters are then submitted to the knob server, who establishes the DecNet connection to the "server" programs on the PDP, pops up a parameter access and control panel on the workstation screen and manages the command and data transfers to and from the servers.

Figure 1 shows the interconnections between the application programs on the workstations, the newly written "servers" on the PDP-11 and the old parameter access software on the PDP.

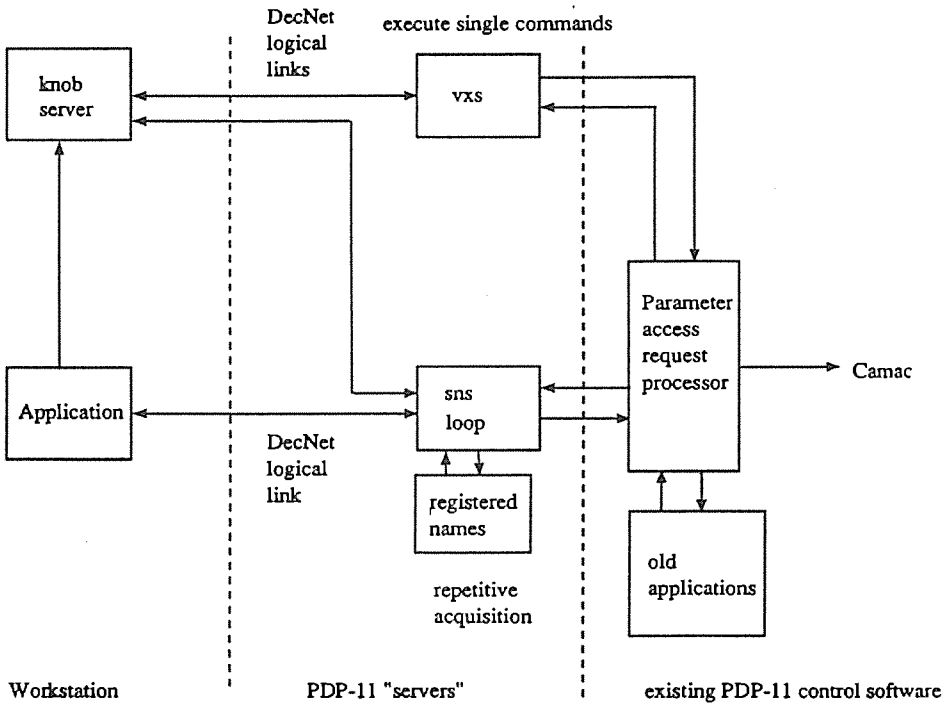

Figure 1 : The system constituents and their interconnection

B. Single parameter access

In order to get access to any single parameter a touch panel simulator has been developed. Each parameter is assigned a button which can be reached over a touch panel tree. Activation of a button may have one of three possible effects:

1) display of a new page;
2) activation of an application program;
3) connect to a parameter through the knob server.

This program has been written as a temporary tool to allow parameter connection and starting of applications until a more performant generic tool of this type (the console manager) will be available.

C. Synoptics

Many application programs simply show the status of an accelerator subsystem like a beamline, an RF subsystem, a timing subsystem, etc. A static background picture shows a representation of the subsystem and active boxes indicate the equipment state with different colors or give their acquisition values in form of numbers. Those types of applications can be generated completely interactively using a synoptics editing tool and its corresponding runtime part. The editor reads a previously designed bitmap (paint programs are available under Motif) and allows to place active boxes freely on top of the background picture. The editor allows to select any of the boxes and connect them to an equipment parameter by specification of the parameter name, and properties like acquisition only or acquisition and control. A status box contains a symbol representing the connected parameter and a color corresponding to the parameters state. For status boxes we can therefore specify the color for a combination of status bits and the filename of a bitmap containing the symbol icon. The result of the editing session is saved on a synoptics specification file which is consecutively read by the runtime part of the synoptics package. The runtime part will reconstruct the image, bringing up the background picture and all boxes at the predefined places. Knowing the parameter

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names from the output file of the editor the boxes are activated by making the necessary calls to the equipment access routines. Figure 2 shows an editing session for a synoptics application while figure 3 shows the running synoptics where a parameters has been selected for control. The control panel displayed by the knob server can be seen.

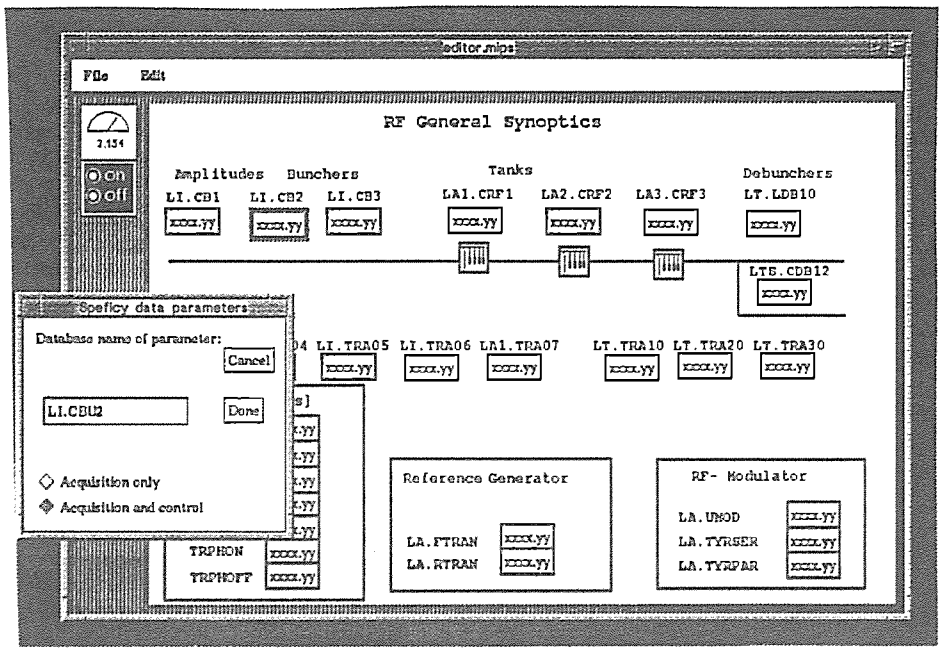

Figure 2. A synoptics editing session

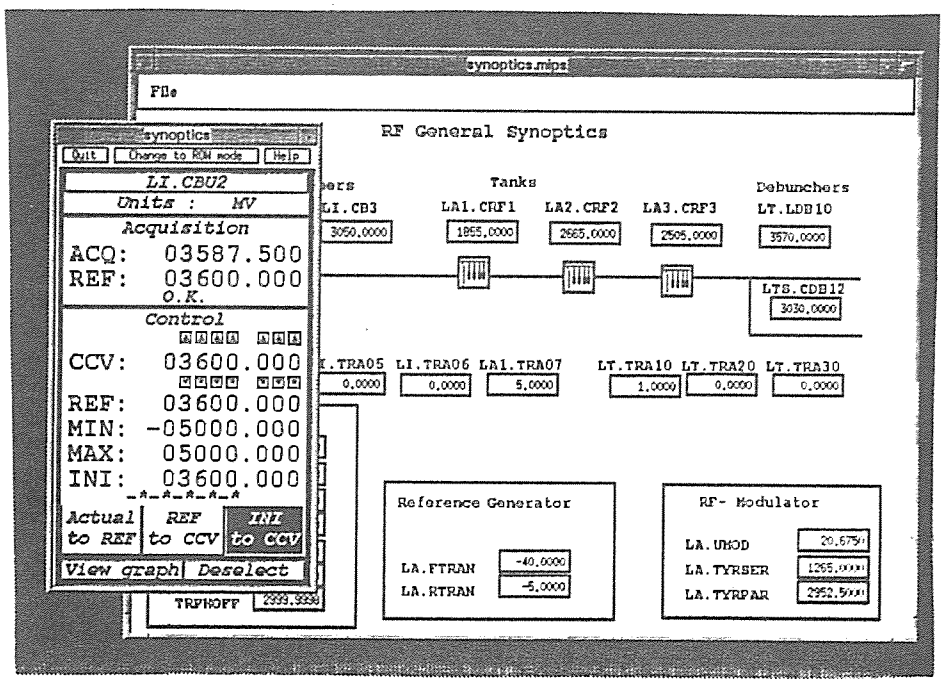

Figure 3. A running synoptics application

D. Logs

On the old Control system several log programs are available. The logs read the parameter names of the equipment who's values are to be logged from a file . Then they acquire the current acquisition values for each of these parameters and write them to a file which is consecutively spooled to a printer and then deleted. In order to get Logs to the Workstation the Log program is remotely executed on the PDP system and the

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resulting file is transferred before being spooled. Finally the file may be displayed on the screen or sent to the local printer.

E. Application programs

Several more complex application programs could not be ported with the synoptics editor because of their graphical representation of the acquired data or because of their more complex data treatment. These programs had to be ported using directly the MOTIF development tools. For the moment this has been done for the Trace3d, a transfer line modelling program[2], the beam loss measurement along the Linac and the transfer lines and the spectrometry measurement. The static part of user interface has been specified in the User Interface Language (UIL) while the active part has been written in C (Motif initialization and callback routines). The emittance measurement programs are about to be ported. Here we tried to use an interactive user interface builder (Dec vuit) which generates UIL at its output. However a big improvement in development efficiency over handwritten UIL has not been seen, perhaps because of our inexperience using the tool.

V. CONCLUSIONS

The project was driven by two principal problems: The hardware consoles used at present in the Linac control room are becoming obsolete and difficult to maintain and access to the Linac control system was needed from the main control room. At present most of the daily operation work on the Linac can be done from the workstations in the MCR. Most of the programs developed so far will be reusable (with slight changes due to different equipment access especially for the repetitive acquisition) for the final system. We will have to finalize the beam diagnostics programs, generate many synoptics with the described tools and do the final switchover to the new system layout replacing the PDP-11 computers by DSCs.

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