EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

CERN/PS/85-23 (CO)
6.5.1985

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Paper presented at the 1985 Particle Accelerator Conference
May 13-16, 1985
Vancouver, B.C., Canada

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Introduction

In hierarchically structured control systems[1,2] like the one at the PS accelerator complex, it is crucial to dispose of means for local interaction at several levels, for engineering purposes. A versatile and user-friendly device has been developed on the basis of Apple's Macintosh.

The device may be used at four levels: (i) autonomously, for checkout of single pieces of process equipment, through a mobile CAMAC crate; (ii) through one or more installed CAMAC crates of the control system, acting on entire subsystems of the process; (iii) as an intelligent terminal and file server, connecting directly to the microprocessor-based auxiliary crate controller in an installed crate of the controls system; (iv) as an intelligent terminal, connecting directly to the front-end process minicomputer.

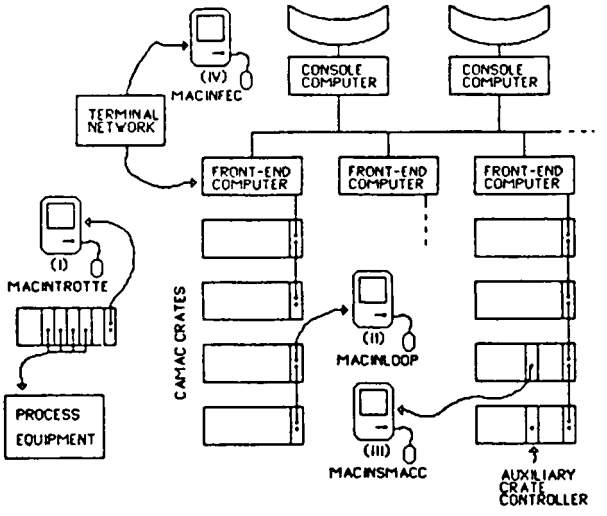

Fig. 1 Interaction levels

The Macintrotte device is composed of (a) Apple's Macintosh personal computer; (b) Apple's Imagewriter printer; (c) a CERN made protocol adapter between Macintosh serial port and CAMAC serial highway; (d) the Macintrotte software package.

The 512 kBytes RAM version of the Macintosh is used, incorporating the high resolution 512x342 pixels display and a 400 kBytes formatted 3"½ diskette drive. Its portability makes it a practical field device in the areas of process interface clusters, where commissioning and engineering checkouts use to take place.

The user language of the Macintosh software is the CERN developed interpreter Nodal, featuring accelerator control facilities, here integrated with the Macintosh user-friendly interaction. This user language, whose MC68000 version has been developed at CERN SPS Division, has been extended to provide high-level primitive facilities for programming and for engineering use.

Interaction Levels

The attraction of the scheme comes from the fact that the same device may be used for diagnostic and operation at widely different levels throughout the control system.

Equipment Testing, with Mobile CAMAC (Macintrotte)

At this first level, isolated process equipment may be tested using a stand-alone CAMAC crate with the relevant I/O modules(s), by way of L2 type crate controller, bit serial. The engineer can develop, save, load and run Nodal programs, acting on the process equipment in question by means of SCAM calls (Nodal function for direct serial CAMAC access), the same as in the front-end minicomputer. He can thus address single parameters or exercise the equipment through intricate cycles, displaying the responses in alphanumeric or graphical form and obtain an image record of the latter in print.

For this application the Macintosh modem port is connected to the crate controller D-port via an in-cable protocol adapter, enabling the Macintosh to control a standard CAMAC serial highway at the rate of 307 kbits per second.

Subsystem Testing by Installed CAMAC (MacinLoop)

At this second level of interaction, the engineer can interact with several CAMAC crates' "worth" of process equipment and thus with entire subsystems which have some meaningful stand-alone function, at least for engineering purposes.

A typical example of operation in this mode will be given in the early phase of commissioning the LEP Pre-injector. One or more of the Modulator/Klystron groups may then be connected in a temporary loop to one or more Macintoshes, which thus stand in for Auxiliary Crate Controllers and Process Computers for which the final operational controls software will still be under development at that stage. Thus, for each Modulator/Klystron group the MacinLoop mode allows to refresh displays of measured parameters and status, to maintain loggings of errors, to adjust parameters and to exercise through relevant sequences, all this through the SCAM facility.

Accessing Auxiliary Crate Controllers (MacinSmacc)

The third level of local interaction is obtained by plugging the Macintosh directly into the serial port of the microprocessor-based Auxiliary Crate Controller (SMACC).[3] In this mode, the engineer can access all process equipment interfaced through the CAMAC crate in question, hence also entire subsystems in many cases.

One difference with the previously described modes is that now the Macintosh sends the Nodal source strings down the serial link to be interpreted by the Nodal resident in the SMACC. Entire programs developed, edited and/or loaded in the Macintosh, which is now used as an intelligent terminal, may thus be run in the SMACC and,while executing, these programs may access the Macintosh diskette.

A second difference is that in this mode Nodal programs coming from the Macintosh can access the process hardware through pieces of the final control software resident in the SMACC, i.e. by high-level Equipment Modules calls. The direct SCAM call also remains available.

The Macintosh can thus be connected to the SMACC with a set of utility programs to perform local

interaction on a crate running on-line.

Accessing the Front-end Minicomputer (MacinFec)

Like for the SMACC, the Macintosh may be connected to the front-end minicomputer. This is through a terminal access network with outlets at process interface clustering points. In this mode, the engineer can access all equipment connected through CAMAC to the ND-100 minicomputer in question, i.e. to a whole process like the LEP Injector Linac (LIL) or the Electron Positron Storage Ring (EPA).

Again, the access is through Nodal source strings from the Macintosh, interpreted by the Nodal resident in the minicomputer. In addition, the ND-100 resources are now available. This is especially useful for mass storage, the ND-100 hard disk being accessible through special file transfer utilities. The facility to load programs from and store files on the Macintosh diskette remains available.

In this mode, composite process variables may be manipulated. The lower levels of interaction, the crate level (Equipment Module) and the CAMAC module level (SCAM functions) remain also accessible through remote execution in the SMACC.

Macintrotte Software package

The most attractive point of the Macintosh is its user interface: graphics screen, mouse interaction, overlapping windows, pull-down menus... This user interface has been integrated for both program development and operation.

Programming facilities

All the system-specific parts of the Macintrotte software incorporate Macintosh user interface. The system commands are all implemented as pull-down menus and dialog windows. For example:

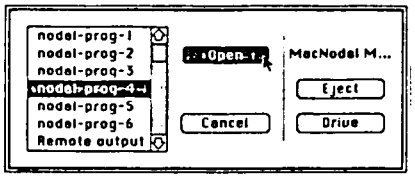

Fig. 2 Dialog window: file loading

Nodal output unit, the MacNodal window, can be used for debugging purposes in conjunction with the trace (?ON/?OFF), Suspend and Continue commands of the Nodal pull-down menu for back-scrolling on a 2 kbytes output buffer.

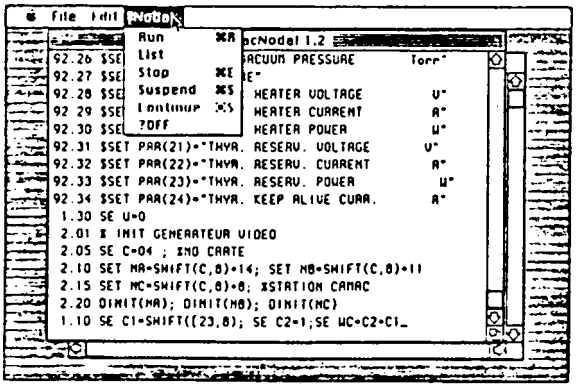

Fig. 3 MacNodal window and menu

The integrated text-editor window gives full-screen program lines editing facility using the Macintosh user interface: scroll bars and mouse action for displacement of the insertion point or for selecting the part of the text to act upon with the Edit pull-down menu. One MacNodal function is used to transfer Nodal program parts from the working area to the text editor, using line numerotation or pattern matching.

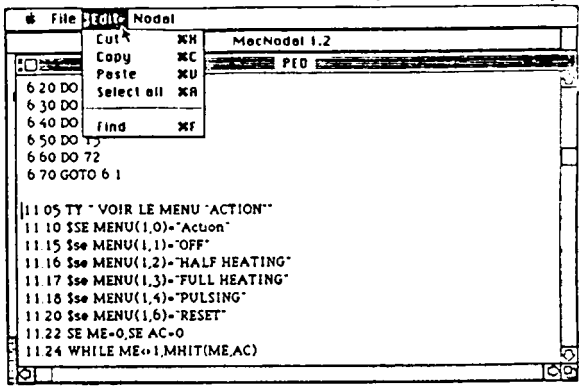

Fig. 4 Text editor window and menu

This window may also be used as a text file for debugging purpose with the Nodal I/O functions.

A specific terminal emulator has been implemented in the system as the remote computer desk accessory. This means that the window "remote computer" may be opened, with an associated pull-down menu, in order to be connected to a remote computer through the Macintosh Modem-Port, without leaving the application. The menu and its associated dialog windows are used for: (i) changing the communication parameters: baud rate, parity.., this setting being kept in a battery powered RAM; (ii) handling the input and output flows between the remote computer and the following Macintosh devices: output window, keyboard, floppy files, printer and text-editor window. The desk accessory window is also provided with buffering and back-scrolling facilities.

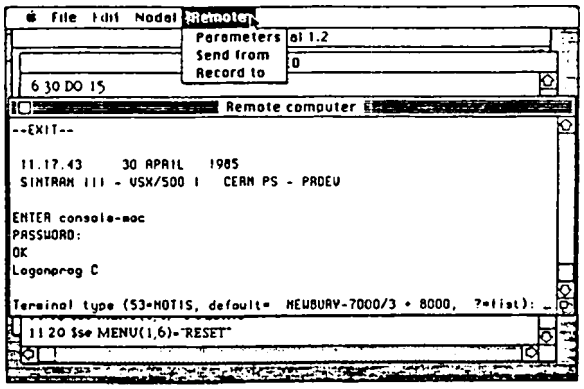

Fig. 5 Remote computer window and menu

The system contains a graphics window which is an emulator of the CERN graphics CAMAC module, DICO-DIME.[4] This means that a standard set of graphics functions is available on the Macintosh either for output on the CAMAC graphics modules or on the Macintosh graphics window, depending on the logical unit number specified. These functions were especially designed for controls graphics.

Nodal functions whose syntax is derived from touch-panel functions, have been added for pull-down menus definition and for testing user action on these menus.

While developing, screen snapshots (bit-map copies to disk) or hard-copies may be used for debugging or for documentation purpose. These snapshots may also be manipulated through the MacPaint graphic editor and printed thereafter.

Operation Facilities

Depending on the connection of the Macintosh, Nodal process commands (e.g. SCAM functions) are either interpreted in the Macintosh or in the remote computer (SMACC or FEC). They can be directly entered at a keyboard with either the MacNodal window or the remote computer window. With restrictions due to FEC Nodal extension or configuration (multiple loops), the process control part of the programs can be written to run under different configurations. Yet the Macintosh specific functions are always interpreted in the Macintosh and present a standard user interface for non-computer specialist operations.

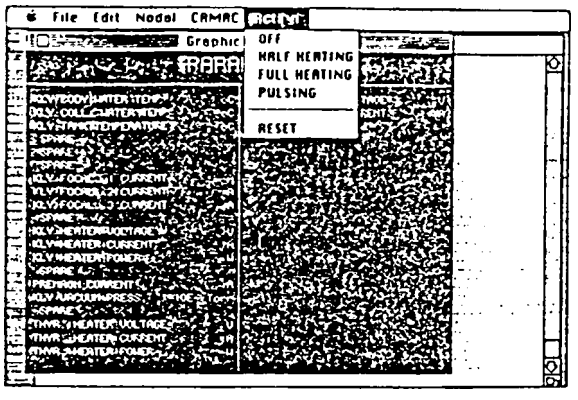

Fig. 6 Sample application

When using the Macintosh connected with a CAMAC serial loop, the CAMAC driver can be used both with Nodal functions (SCAM) and as a desk accessory, through the controls of a dialog window and dedicated menu.

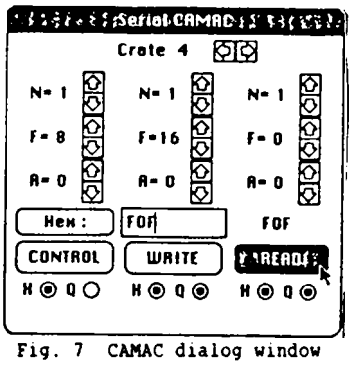

Fig. 7 CAMAC dialog window

The operator can thus select CAMAC Crate, Station, and function, enter values with selected format through the keyboard and execute function (Control, Write and Read buttons). Acquired values and X,Q responses are displayed after each CAMAC transaction.

These two modes of control can be used simultaneously, for instance to change the value of a power supply through the interactive window while running an acquisition program with requested graphics.

When used with remote process computer connection (SMACC or FEC), the remote computer desk accessory stands for (i) a terminal of the remote computer, (ii) a driver for accessing this channel from Nodal in the Macintosh, (iii) a file server for the Nodal of the SMACC, (iv) a remote procedure call server for execution of Macintosh function (user interface and graphics) while running Nodal program on the SMACC.

Extension to workstation

The extension of the interactive tools available for operator programs can make the Macintosh into an autonomous workstation connected to FEC via terminal network. Each station can be provided with its own operator modules either to be run by the FEC, with user interface functions remote execution on the Macintosh, or to be run on the Macintosh with process functions remote execution on the FEC. Here follows an example of what could be the Macintosh version of an existing console operator module, the graphical display of magnetic field value.

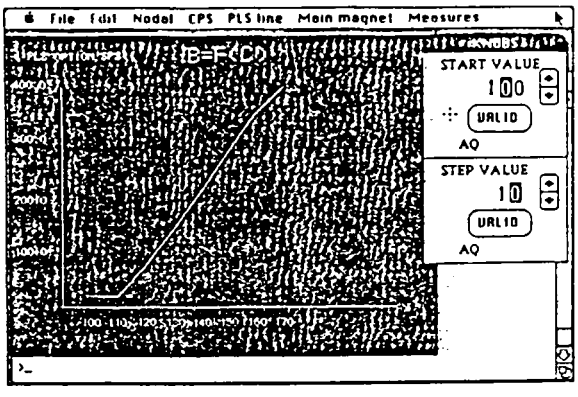

Fig. 8 Sample of operator modules

These autonomous workstations could then function as local mini-consoles usable from anywhere, provided there is a terminal network connection. For this application, the non-transportable Macintosh XL version could also be used, it has a larger display, a hard disk and 1 Mbytes RAM. A single FEC channel could also be linked with a Macintosh network, each unit running a single operator module and using the FEC task as a process commands server.

References

[1] G. Baribaud, S. Battisti, G.P. Benincasa et al, "The Improvement Project for the CPS Controls," Trans Nucl.Sci., Vol. NS-26 No.3, p.3272, 1979.

[2] B. Kuiper et al, "Controls for the LEP Preinjector," this conference.

[3] W. Heinze et al, "SMACC," this conference.

[4] P.S. Anderssen and M. Flückiger, "User Manual for the new 68000 DICO," CERN/SPS/ACC-CC/Note 82-42, 1982.

[5] F. Perriollat and F. Di Maio, "Macintrotte," CERN/PS/CO/Note 85-01, 1985.

[6] F. Di Maio and C.H. Sicard, "MacinSmacc," CERN/PS/CO/WP 85-32, 1985.