The CERN-PS Controls System Operational Aspects

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Abstract

The PS controls system is being upgraded since March 1992. Four out of the nine machines of the PS Complex are already operated through the new workstation and VME crates environment. The operation interface presented at ICALEPS in October 1993 is the result of a collaboration between the Controls group and the Operations group. It was designed in order to bring to the operator a uniform environment integrating parameter controls, beam measurements, alarms and general information. The pulse-to-pulse modulation of the controls which needed to handle sequentially different types of beams has been redesigned. This paper describes the main lines behind the lay-out of the operation tools. Comparisons are drawn between the current and the new systems from the practical point of view of the user; errors and successes are mentioned, as well.

1. THE FORMER SYSTEM

The control system installed in 1981 was the first system to offer a computer solution covering all the operation aspects. Controls were performed through a bunch of identical mini-computer driven consoles and the equipment was accessed by CAMAC crates organised in serial loops controlled by FECs. The console lay-out as well as the parameter access and the application programs had been specified in detail by a team of operation people [1].

The consoles were divided in 4 standard sections in which appropriate tools were available (Fig. 1) :
- a Controls and Measurement central section using a graphics screen and a colour TV to display data plus touch-panels, 4 knobs, one track-ball and a keyboard to handle the parameters
- an Analogue Signal Observation System to visualise on 4 digital oscilloscopes 8 among 1600 signals,
- a Video Signal System to observe beam monitors or display equipment information on 4 black and white TVs,
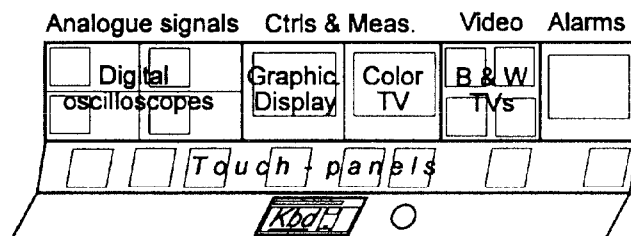
- an Alarm Display to get automatic information on faulty pieces of equipment as well as a tool to reset them.

The main principles behind the controls were the following :
- Standardisation : identical consoles able to access any machine of the PS Complex with identical protocols and user interfaces.
- Pulse-to-Pulse Modulation (PPM) : most of the equipment settings vary according to the type of beam. To produce in sequence different types of beam, a modulation with time of the machine parameters is necessary. This modulation is driven by information describing each beam by a set of "properties" [2]. Different combinations of these properties (e.g. particle type, energy, extraction type) are required to provide different beams. Using the same property in several beams induces a coupling between these beams. Eight different beams could be handled at a time.
- Tree-structure : the parameters are accessed through a selection Machine/Operation/Sub-set/Parameter. The whole access structure is pre-defined and modifications can only be made by specialists. Different "Trees" are provided for different classes of users (operation, hardware or software specialists, Machine Development).
- Reservation : at the sub-set level, a reservation process is activated to make sure that the parameters of this sub-set can only be accessed by a single user for the type of particle beam that this user defined. As a drawback, at a given time one can only adjust the parameters of the sub-set which has been reserved.

2. GENERAL FEATURES OF THE NEW SYSTEM

This system uses the nowadays current architecture of an Ethernet backbone linking workstations, VME equipment crates and a powerful on-line database. Based on the experience gained on a prototype realised in 1990 [3], the
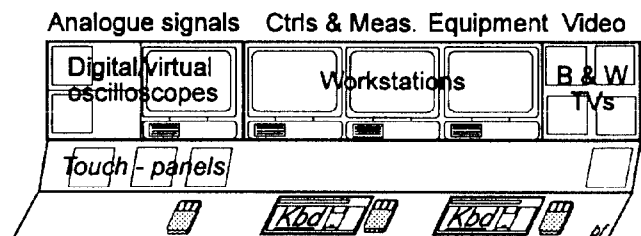

Fig. 1 : Current Console lay out

Fig.2. New Console Lay out.

system which has been implemented since 1991 presents the following characteristics :

2.1. Operation consoles

The concept of console has been kept to provide the operator with a sufficient number of simultaneous information and controls. These consoles currently contain 4 workstations plus dedicated equipment, still needed in a transitory period (Fig. 2).

2.2. Workstation lay out

To start an operation session on a workstation, the machine to be operated has to be specified. According to this specification a "Console Manager" window is activated presenting pull-down menus through which one can access all the tools needed to operate this machine [4]

2.3. Operation Contexts

The Console Manager allows the operator to awake a certain number of tools which constitute a "Context". Several Contexts addressing different beam operations can be built and stacked. Each of the Contexts is linked to a single type of beam for clarity. They are exclusive and occupy a complete screen (Fig.3); the access to any of them is performed through the Console Manager.
The basic components of a Context for operation are :
- "Working sets" windows,
- "Knobs",
- Measurement programs or application programs to access sophisticated controls,
- Information window to handle controls messages
Each of these components appears on the display with default sizes and locations so that they can coexist on the display and be used without dragging and resizing.

2.4. Equipment Tools

These are hardware-oriented tools developed for the operation people and for the controls exploitation team They are also started from the Console Manager but are not context-related . They consist of :
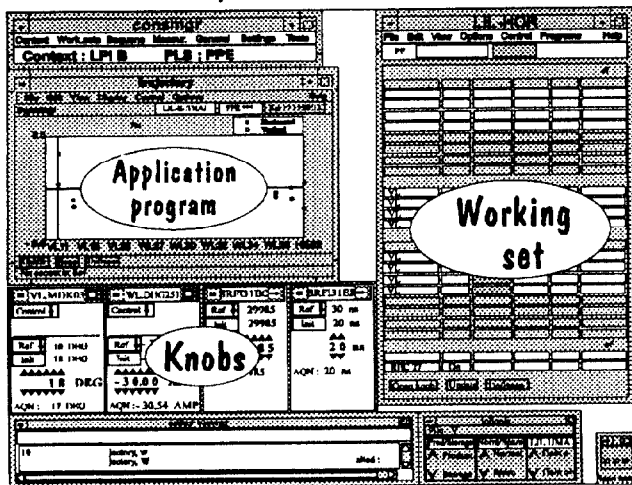

Fig.3. Typical Context.

- an "Alarm handler" which displays information about the faulty pieces of equipment and allows for reinitializing either parts of the controls system or the machine equipment,
- an "Equipment handler" which gives access to the elementary command steps on any equipment of the machine,
- virtual oscilloscopes to display selected analogue signals digitized locally,
- a Function Generator editor to build analogue functions vector by vector,

3. ORGANISATION OF A CONSOLE

Although any control can be performed from any workstation, the workstations in the console have been assigned to certain tasks corresponding to what has been thought to give maximum efficiency for operation.
The same four sections existing in the old consoles have been implemented again in these new consoles :the "Controls and Measurement" section, the "Equipment" section, the "Analogue Signal Observation System" and the video system unchanged but for the possible embedding of one selected video signal on a workstation.

3.1. Controls and measurement section

This section consists of one workstation with 2 screens. Each of the 2 screens gets its own Console Manager which accesses 8 Contexts. Practically, these Contexts are used to contain the different environments (Working sets/Knobs/Application) prepared to handle the different aspects of the production of the beam currently delivered to the physicists.
- The Working set windows are activated from the Console Manager; they come as lists of parameters along the right edge of the screen which can be extended to display Setting and Reference values. Background colours are used to inform the operator about the status of these parameters.
- The Knob window : it appears at the bottom of the screen and presents in a row the knobs which have been activated to perform individual adjustments. Selecting parameters from Working set lists is the main mechanism to open knobs. All the parameters which have been affected to knobs in a Context appear in that window, regardless of the Working set from which they have been selected. Any number of knobs can be activated and a scroll bar is used when more than 5 knobs are requested. The knob in itself is a widget defined for every class of equipment; it handles the status, the control, the acquisition and the reference values of the parameter. Each knob can also present more specialised information on alternative pages.
- The Application Window : presents either tools dedicated to some sophisticated setting which cannot be properly performed through knobs or a measurement device with its own controls, graphical or alphanumerical displays. The application programs are opened from the Console Manager. Machine parameters that would need to be adjusted as part of the measurement procedure can be hooked to knobs from

within the application. Whenever possible, these application programs are made generic.

The interactive synoptic approach has not been chosen to control the machine parameters despite its very attractive visual impact on visitors because it needs much too large screen surface and much "mousing" around to perform the actions. Using lists of parameters with meaningful names and concentrating the interactions in fixed areas proves to be more efficient for professional operators. Nevertheless, synoptics exist as passive maps to help the operator when needed; they appear in the application program area.

3.2. Equipment Section

The second workstation of the console is used most of the time to display the "Alarm Handler". A continuous survey of the equipment status is performed and the faulty parts are shown. Detailed information is available and set-up tools can restart the equipment which is not really damaged.

Alternatively to overcome controls problems not handled by the Alarm Handler, the Equipment Handler can be activated on this workstation to access directly the equipment.

3.3. Analogue Observation System

A new system [5] has been developed based on local VXI crates incorporating analogue multiplexers and oscilloscope-like digitizers producing data transmitted through Ethernet. On the workstations an application program drives the selection of the signals and presents virtual oscilloscopes capable of displaying up to 12 signals simultaneously, with a total processing delay < 100 ms . This system will completely replace the former system within 3 years. Currently, 2 machines use this new system exclusively and a third one is partly converted. Thus the operation consoles still include 2 digital oscilloscopes needed by the existing system in addition to the workstation used for the virtual oscilloscopes.

4. THE CONTROL ROOM ENVIRONMENT

Besides the operation consoles other tools are available to help in operating the machines :

4.1. PC network

In the control rooms, a series of PCs linked to the "Office" Ethernet network [6] can access the machine parameters through a link towards the "Controls" Ethernet . This is used by Machine Development people, developing dedicated and volatile controls environment to perform tests. The same PCs are also used by the operators as a logging device readable from any office and as access terminals to databases for schedules, specialists call lists and statistics.

4.2. General Information

A number of large video displays around the Control Room repeat the most important information coming from the PS machines as well as from the other

CERN machines using our beams. This information system is being modified to make use of standard multi-channel commercial TVs.

5. ARCHIVES AND PULSE-TO-PULSE MODULATION

Instead of being driven by a set of Properties, each beam is now described by a single label which drives directly the machine parameters. Up to 24 beams are now possible which are all independent. Without coupling between beams, it is now possible to store in archives and retrieve easily complete "Virtual machines". Copy programs capable of duplicating all or part of the parameters of one virtual machine to an other are used when identical settings have to be applied to different beams.

6. CONCLUSION

The use of workstations extended the operator control possibilities by having better tools; nevertheless a console concept was kept and display space was carefully allocated to the different tools to maintain a clean and efficient environment without any hidden information.

Trying to compare the new and the old Controls systems, one notices that the only original option which has been suppressed is the reservation of parameter sets. The Pulse-to-Pulse Modulation is now more simply based on the concept of "virtual machines" allowing decoupled beams and archiving of complete machine settings.

All the other principles have been kept and extended according to our increased needs and to the power of the new controls architecture :
- Uniform access to all the parameters, from identical consoles or single workstations with standard user interfaces
- Beam-oriented operation contexts, with the ability to switch rapidly between them to handle the current adjustments,
- Direct access to the measurement devices and to the machine parameters with an increased number of knobs.

7. REFERENCES

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