

THE SIN CONTROL SYSTEM

P. Aeschimann L. Besse, I. Jirousek, A. Jucker, S.I.N.,
Swiss Institute for Nuclear Research, 5234 Villigen, Switzerland

Abstract

The accelerator's central control is organized around one two way data transmission system which address and data are transferred parallel. The control computer will carry on all the data movements on very high speed by using the lines at short intervals. Therefore, most of the time the lines not being used by the control computer would also become available to lower priority, less frequent communications. The installation of the few manually operated "setpoint controllers" requires additionally only one single "busy/enable" signal to organize the communication priority on the shared line (ROAD-System).

1. Is Manual Operation still up to date?

The potential advantages of computer control are well known. But how to overcome certain limitations or disadvantages? For example, you would like to have full computer control on every parameter and all readings, if you tackle with hundreds of those values at the same time. By setting up complete beam lines it is nice to pass on the control to the computer and use predefined time functions and precalculated values. Also logging or periodic supervision through the computer is very economic and done in a powerful way.

However, some other individuals around the accelerator would prefer to be private, somehow with their "own" device. They want to turn knobs and read magnet currents without having to line up the computer console to share program, and to wait for display. In order to help those people it is not necessary to go back all the way and use additionally analogue instrumentation. Since our time address multiplexed signal transfer interchanges data between control computer and local devices with the very high speed of 100 k word/s, most of the time the shared lines became also available for data, generated by other sources such as control computer.

2. Setpoint Settings, Command, Stations

We therefore consider and build manually operated devices as a "setpoint setting". They are connected directly to the "ROAD" system and they control reference values for each power supply independent of the computer.

It is also possible to alter those reference values by turning knobs, up or down, in order to read the magnet currents and to

operate position servos for slits and beam probes. The "setpoint setting" therefore generates all the commands being identical with those used by the computer. The "setpoint setting" is a 19" standard rack mountable device. The front panel (Fig. 1) has been designed to be able to learn the operation easily. One unit is capable of controlling as many as 69 power supplies, 16 position servos and four slits or degraders. Of course, every power supply might receive control commands from any ROAD interfaced source such as control computer, and from two or more setpoint settings and command stations, without changing plugs or switch positions.

Actually, we have seven of the setpoint settings in operation at the control room (Fig. 2). We also expect to use the same kind of control device by experimenters outside the control room for adjustment of the

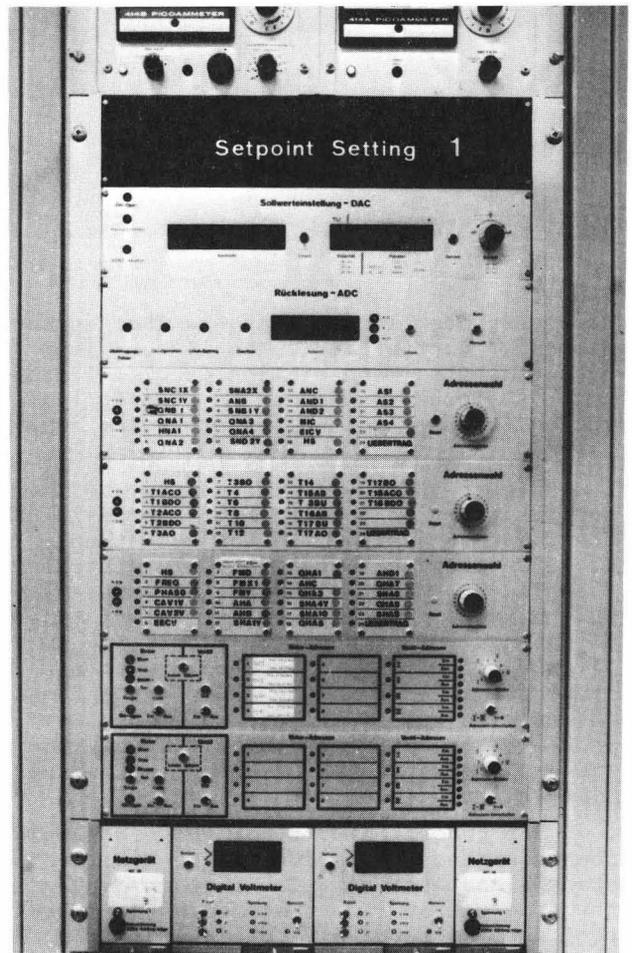


Fig. 1 Setpointsetting



Fig. 2 Partial View of the S.I.N. Control Room

secondary beam lines. They are the "command stations" controlling up to 16 beam line groups. The command station is also linked to CAMAC Dataway in order to transfer information from and to the experimenters computer.

Fig. 2 shows a dedicated part of the control room. On the left side there is the control desk of the injector cyclotron (72 MeV). On the right hand the main control desk is shown which includes all the keys, push buttons, display etc. for human access to the control computer we are having now. (It has already been decided to have also a second console for human access in the near future). On top of the control racks, as shown in the background, there are TV monitors to display computer generated information. (Tektronix 611 ↔ TV link).

The concept of the control racks has been designed to provide the centralized stand-alone operation for certain parts of the accelerator (i.e. beam guiding 72 MeV ring cyclotron 600 MeV, beam guiding 600 MeV and target stations) by having all the necessary instrumentation in such a group

close together.

To obtain complete control of those groups, we installed setpoint settings to each of them. Since they are operating independently, the accelerator people could fiddle with all the groups simultaneously. The second and fourth rack show such a setpoint setting belonging to 72 MeV beam guiding respectively to the magnets of the ring cyclotron.

3. Technical Pinpoints

Setpointsettings

The ROAD System (Fig. 3) performs three basic tasks:

- the control computer to local equipment talks;
- the setpoint settings to local equipment talks, and
- the control and console computer inter-communication.

However, all data passing to and from one control device are directed by priorities on the line and by using constant time

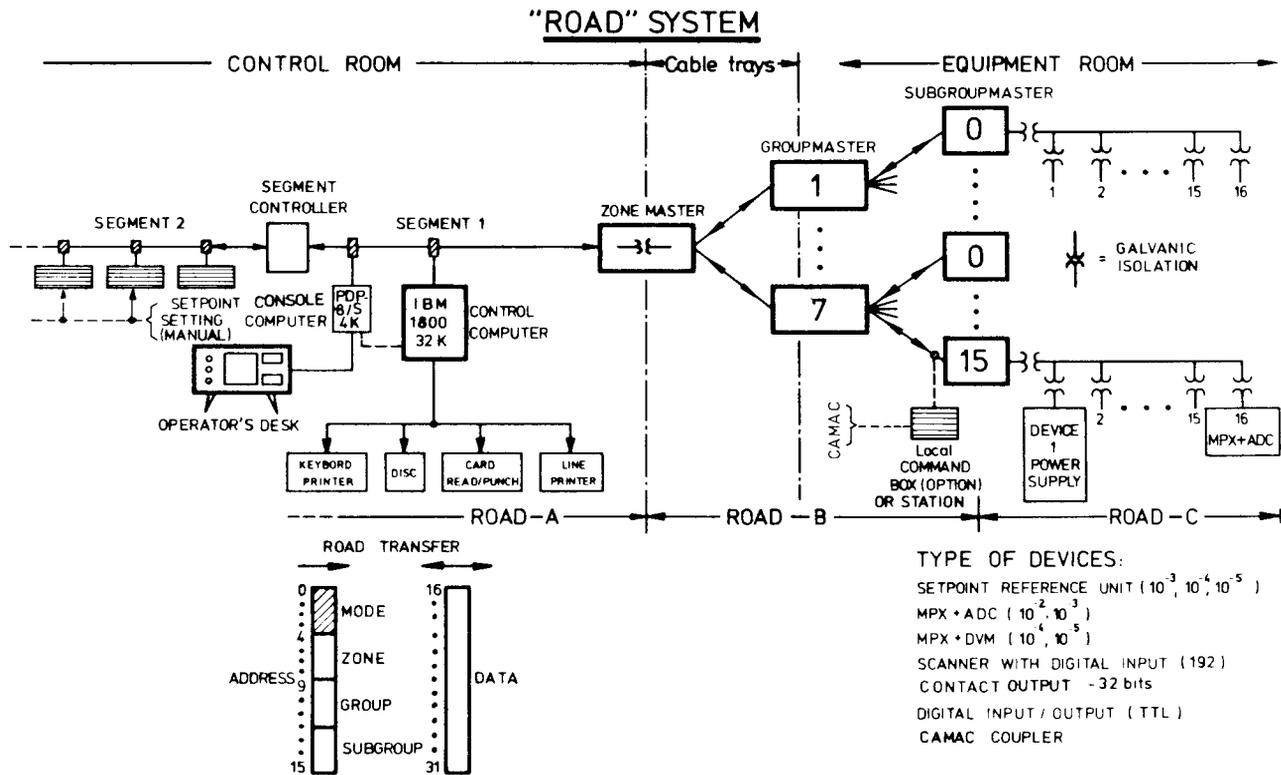


Fig. 3 ROAD-System

periods, while the shared times are exclusively available for two partners only.

The conceptual design of priorities is a top-down scheme. The control computer is certainly on the highest level. Every time the computer has to communicate it holds down the "busy" signal as long as block transfer is successfully carried out and other active devices have to wait. After finishing the transfer the busy signal is turned off. The ROAD system becomes available for the next device from the top which again turns on the "busy" for all the active stations downstream during the time it is transmitting information to the partner.

It is clear that devices at the lower end of the priority chain are, at least theoretically, more often interrupted than the upper end but since the communication rate is as high as 100 kc/sec. the manual operator of the setpointsettings will in practice not be able to observe any delay.

Also the highest possible communication density is generated manually is few order of magnitude lower than generated by computer, therefore, the additional loading factor on ROAD is negligible.

Command Stations

We have also found it useful to support

the experimenters on the secondary beam lines with devices similar to setpointsetting. It was also understood that the front panel functions have to be identical with setpointsetting in order to avoid misunderstandings by operation with such a device. Fig. 4 shows a command station controlling the medical beam line.

Since the priority scheme described before is available in the control room only, other methods were studied for simultaneous communication. As a result of these studies the command station uses the interval-time-lag between two subsequent information given by signal prorogation delay from and to the control room (interval cycle steal method). Once the simultaneous communications between central control and local command stations were solved the experimenter also asked for computer connection via Camac. This option is now also included yet in the command station and provide the experimenters with his own computer power to twiddle magnet power supplies, via ROAD, as far away as a few 100 meters. (To cover such distances by Camac is more expensive than by ROAD.)

4. Conclusion

It is worth pointing out that the human interface to the technical system is one of the very important but most confusing problem of today.

In actual practice, around the accelerators there exist many powerful and expensive computer installations connected to digitalized operating controls.

The success with such a control system does not depend upon the computing power only, but also upon properties such as easy and direct availability to more than two or three persons simultaneously. Therefore, the system designer has to consider carefully how the control system can assist simultaneously all the people doing some work on the accelerator.

It has been recognized for some years, however, that the terminals available from computer manufacturers are generally not utilized for the control of accelerators, because of cost, difficulty in operating the keyboard, slow response, lack of knobs and switches for specific tasks, etc.

For very many reasons most of the human control actions are not so complicated that they would use up the potential power of the central processor. But how do you solve simple actions like varying a parameter without using computer terminals?

In case that people want to vary some parameter at the same time it becomes clear that the quick twiddlings can be separated from the computer by using setpoint settings.

(Nevertheless, if the computer does this job for you the programming can be a complex task). The routine use of the computer console is therefore reserved for more or less complicated logical operations, multiparameter calculations, set up procedures of complete beam lines, strategies to optimize beam properties, alarm debugging, off line beam transport calculations, etc.

5. References

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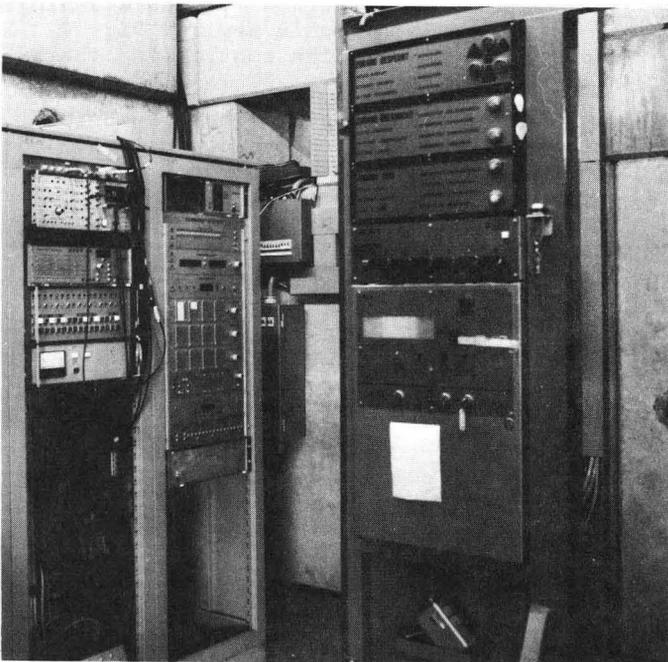


Fig. 4 Command Station