Planned Upgrades to the SRS Control System

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Abstract

A project is under way to replace control and monitoring of the SRS main magnets with a new PC control system. The development will be strongly based on the CERN ISOLDE control system. Future upgrade plans include addition of the beam steering and injection systems. This paper will discuss the options considered for upgrade and the benefits likely to be obtained from the chosen system.

1. INTRODUCTION

The SRS is a second-generation 2 Gev synchrotron radiation source[1]. The control system, in common with the rest of the accelerator, was designed and commissioned in the late 1970's. Since that time, much of the original computer hardware has been upgraded and the software has continued to develop. The basic design and philosophy of the control system has, however, remained largely unchanged over the last 15 years.

The system presently in use is based around 3 3200 series processors produced by Concurrent Computer Corporation. Interfacing to the plant is provided by 3 serial CAMAC highways driving a total of 17 crates. The operator interface is provided by 3 Tektronix 4207 colour graphics terminals that are connected to the system via RS232 links driven from a parallel CAMAC branch (Figure 1)[2].

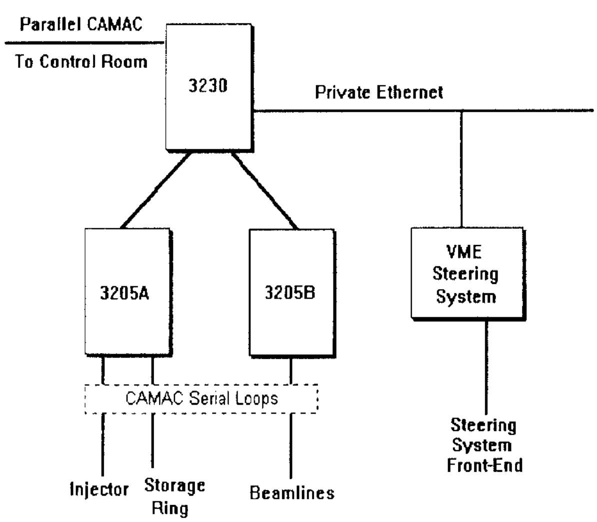

Figure 1. Existing SRS Control System Layout

A recent addition has been a VME sub-system to handle all the beam steering and monitoring functions as well as providing beam position feedback control. This sub-system is described elsewhere in these proceedings [3].

During the last few years it has become increasingly clear that the control system as it stood in the early 1990's would not be able to meet all the demands that are likely to be placed upon it in future years. Therefore, a number of possible upgrade options were considered to try and establish the best way to proceed.

2. UPGRADE OPTIONS

Following a review of planned and recently implemented accelerator control systems several distinct trends in control system implementation were identified. Three of these trends in particular were seen as requiring further investigation. They are:

1) Commercial, Turn-key control systems,
2) 'Generic', UNIX workstation based systems and,
3) PC-based control systems.

2.1. *Commercial*

Recently, an increasing number of hardware/software products have become commercially available that offer to provide a complete control system package. The majority of these packages seem to be most suitable for use in small industrial or laboratory systems where the number of devices to be controlled is typically 20-30, but some packages are available for larger industrial and accelerator control systems, e.g. Vsystem from Vista Controls Inc.

This approach has several advantages when constructing or upgrading a control system:

1. Relatively quick and easy to implement.
2. Provision of software tools optimised for control system use - Drawing packages, Alarm systems etc.
3. Support and backup from the manufacturer and/or distributor of the system.

Among the disadvantages of this approach are:

1. Reliance on custom software and/or hardware from a single-source supplier.
2. Long term support issues - will the manufacturer still be in business in 5 or 10 years time?
3. Integration with other software packages (spreadsheets etc.) can be difficult.
4. Difficulty of adding support for 'non-standard' devices.

2.2. *Generic UNIX*

Several accelerator control systems have been designed using what may be called the 'generic' UNIX architecture. This consists, basically, of an Ethernet backbone using UNIX workstations as operator consoles and with further workstations and VME systems (usually) at the lower levels performing plant I/O functions. The Graphical User Interface (GUI) in use is almost always X-Windows. Many of the more recent accelerator projects have adopted a design similar to this for their control systems (e.g. APS, ESRF, etc.).

Some of the advantages of this approach can be summarised as follows:

1. Utilises 'open' standards - TCP/IP, NFS/RPC, X etc.
2. Provides a very flexible system with excellent expansion and upgrade facilities.
3. Progress in achieving 'commonality' has been made by the EPIC collaboration[4].

Disadvantages include:

1. Requires a large amount of programming effort (this should be reduced by the EPIC project).
2. UNIX systems are complex and difficult to maintain.
3. There are a limited range of native UNIX applications for data collection and analysis (spreadsheets etc.).

2.3. *PC-Based*

The third technique considered for possible use on an SRS controls upgrade was a PC-based system. This is an approach that has not yet gained widespread popularity but is slowly being implemented or considered for an increasing number of systems. The architecture is essentially the same as that used by the 'generic' UNIX design discussed above but replacing UNIX workstations with PC workstations running Microsoft Windows and utilising industrial PCs as front end systems wherever possible. Until the last few years PCs have not been able to provide adequate processing power to justify their use as a central element in a medium/large scale accelerator control system, however, top-end PCs can now challenge mid-range UNIX workstations for performance making this approach a realistic option. For the purpose of evaluation we looked at a system developed for the ISOLDE facility at CERN [5].

The advantages of this approach are:

1. Makes full use of 'market-leader' applications packages for application development and for data presentation.
2. Uses a minimum of custom software
3. PCs provide an inexpensive, easily manageable system.

Disadvantages that need to be considered include:

1. Reliance on a simple, single tasking operating system (DOS).
2. Care must be taken when choosing a PC supplier to ensure reliable, high quality hardware.
3. Provision must be made to ensure maximum inter-operability with UNIX-like systems for compatibility.

Following this investigation of possible options we decided to choose the PC-based system as developed for ISOLDE as the model for an SRS control system upgrade. This decision was made because the system provides a good compromise of flexibility, easy installation, quick software development and good price/performance ratio.

3. UPGRADE PATH

3.1. *The ISOLDE control system*

The architecture and operation of the ISOLDE control system has been described in detail elsewhere [5,6]. The system that has been purchased and installed for the first phase of the SRS upgrade is shown in Figure 2.

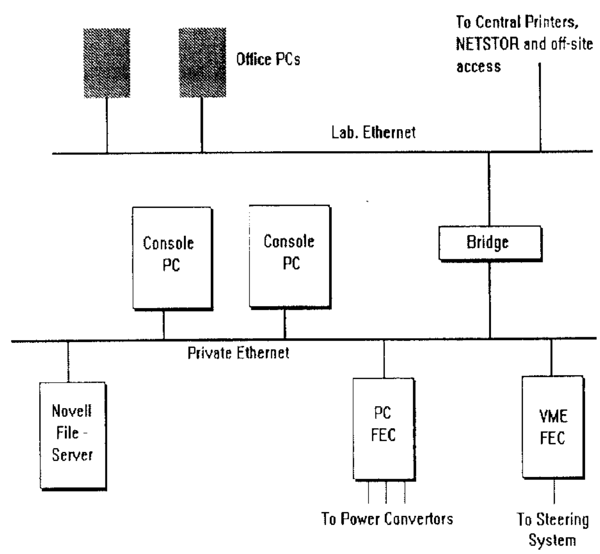

Figure 2. Layout of SRS Controls Upgrade

Briefly, it consists of:

1. A Novell Netware 3.12 File server with 1 Gb disc
2. Two DX2/66 Windows workstations
3. Two DX/33 Industrial PCs for use as Front End Computers (FECs)
4. A Bridge to the laboratory Ethernet for access to central printers, file stores etc.

3.2. *Upgrade Stages*

The first operational use of the upgrade will be to control new magnet power converters that are currently being installed on the SRS at Daresbury [7]. These converters provided a natural choice for the first phase of the upgrade because they incorporate intelligent micro-controllers and communication is via 20 ma current loop interfaces. The old

SRS control system can not easily incorporate devices of this type.

Work on this phase of the project is already well underway and operational use of the system is expected by early 1995.

The second stage of the upgrade will involve integration of the existing VME based steering control system with the PC system. Initial trials have already proved that the ISOLDE system can satisfactorily communicate with a VME system (running OS-9) in the same way as with a PC FEC. When this phase is completed control of the most important physics devices on the storage ring (i.e. main magnet, steering magnets and BPMs) will be possible. This is planned for mid 1995.

Subsequent developments are likely to include transfer of plant presently controlled via CAMAC to the new system. A PC to CAMAC parallel branch interface has already been purchased and evaluation/development in this area can be undertaken in parallel with the earlier stages of the upgrade.

4. Benefits

It is anticipated that the gradual introduction of a modern control system will bring benefits to the areas of machine operations, system maintenance and software development.

4.1. Operations

Transfer to a control system providing a GUI (Microsoft Windows 3.1) should produce an immediate improvement in productivity compared to the single-tasking, command-line based interface provided by the old system. On-line analysis and processing of data collected by the control system will be possible leading to faster detection and response to abnormal machine operations. A large bonus is that many people are already familiar with the Windows environment and its applications thus reducing the training time needed to become familiar with the system.

4.2. Maintenance

One of the major disadvantages of the old control system is the cost of hardware maintenance. It is confidently expected that the annual maintenance costs of the upgraded system will be considerably less than that of the old system. More in-house maintenance will also be possible because of the widespread familiarity with PC hardware systems and the ease with which spares and add-ons can be obtained.

4.3. Software development

The availability of sophisticated program development tools such as Visual Basic, Visual C++ and Microsoft Excel will allow applications software of a much higher standard to be produced for the new system. Also, a common 'look and feel' to the applications will also be possible, thus reducing operator training requirements.

5. Conclusions

The design of modern accelerator control systems is following a small number of distinct trends. This should mean a greater degree of compatibility between systems than has existed in the past. In turn this has created an opening for commercial 'turn-key' systems. In seems clear that in future, there will be increasing use of these commercial solutions as well as greater collaboration on control system design between accelerator laboratories.

The system that has been chosen for the SRS controls upgrade will provide many improvements over the old system particularly with regard to the user interface. This should help to increase the operational efficiency of the SRS.

6. Acknowledgements

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7. References

[1] V.P.Suller et al "SRS-2: Performance and Achievements", Proceedings of Particle Accelerator Conference, Chicago, March 1989.

[2] D.E.Poole, W.R.Rawlinson, V.R.Atkins "The Control System for the Daresbury Synchrotron Radiation Source" Proceedings of the Europhysics Conference on Computing in Accelerator Design and Operation, Berlin, September 1983.

[3] W.R.Rawlinson, B.G.Martlew, M.J.Pugh, M.McCarthy, "Development of a VME-Based Control System for the SRS Orbit Feedback Project", Proceedings of the 1994 European Particle Accelerator Conference, London, UK, June 1994.

[4] M.Knott, D.Gurd, S.Lewis, M.Thuot "EPICS: A Control System Software Co-Development Success Story" Proceedings of the 1993 International Conference on Accelerator and Large Experimental Control Systems, Berlin, Germany, October 1993.

[5] I.Deloose, A.Pace "The ISOLDE Control System" Proceedings of the 1993 International Conference on Accelerator and Large Experimental Physics Control Systems, Berlin, Germany, October 1993.

[6] A.Bret, I.Deloose, G.Leo, A.Pace, G.Shering "The Isolde Control System Reference", CERN PS/OP/Note 91-17.

[7] D.E.Poole, M.T.Heron "Upgrading the Main Magnet Power Supplies on the Daresbury SRS", Proceedings of the 1994 European Particle Accelerator Conference, London, UK, June 1994.