INTRODUCTION

The SPES Target and Ion Source prototype is undergoing the first ionization test, after more than two years spent in its construction and instrumentation setup. The Target control system covers two basic areas of functionality: those related to the safety and those concerning with the operation of the general purpose instrumentation (including beam transport devices). Of course, safety and instrumentation controls are strictly interlocked, but their practical implementation is based on different technological approaches.

While PLCs are extensively used for safety and vacuum control [1], EPICS IOCs are used for the control of several kinds of power supplies and for beam diagnostics. This paper describes the technical solutions adopted on both IOC and client sides and gives some hints on plans for future developments.

THE CONTROL OF POWER SUPPLIES

Three types of power supplies are currently installed for Target operation. High current supplies are required to heat the target and bring its temperature to the value of about 2000 °C, necessary for the optimal extraction of ionized fragments. To this purpose, we use a set of LAMBDA GENESYS modules connected in a master-slave configuration. The master communicates with the IOC through a RS232 interface; the IOC is a standard PC running under Linux (CentOS distribution). To provide the electrical isolation from ground (target and power supplies are both installed on a high voltage platform) we use a fiber link over Ethernet and an Ethernet to RS232 multi-port converter (Comtrol Device Master).

The EPICS driver is derived, with minimal modifications, from that developed at PSI [2]. This driver is based on StreamDevice, an easily configurable Device Support specifically designed for instruments equipped with string-based communication interfaces.

High voltage power supplies are used for the electrostatic deflectors (one triplet is placed at the output of the ion source). These devices are manufactured by UltraVolt; the control is accomplished through analog interface. The IOCs used for the control of UltraVolt power supplies are PC-104 microcomputers manufactured by CosyLab (A/D MicroIOCs). These controllers run under a customized version of Linux Debian and come with Epics drivers pre-installed. A microIOC of the same type has been used for the control of the power supply feeding with high voltage the platform on which the target is installed; this device is a FUG HCP series, delivering a voltage up to 60 kV.

BEAM DIAGNOSTICS

A Faraday cup and a grid-based beam profile monitor have been placed at the ion source output to measure the current and characterize the profile of the extracted beam. Since the acquisition of samples of grid currents requires a deterministic timing (analog signals are sampled at a fixed rate and transferred to the acquisition system in form of a serialized stream) the IOC dedicated to beam diagnostics is implemented in VME hardware and runs under the real time OS Vxworks. The crate controller is Motorola MVME3100 and the Vxworks release is 6.7; the board used for data acquisition is XVME-566 (12 bit and 100 KHz of sampling rate). The XVME-566 driver was customized [3] to support the configuration of on-board timer Am9513, used to generate the clock pulses for the analog multiplexer serializing the grid signals. Insertion of grids along the beam line is accomplished by means of a stepper motor; the controller is implemented in a VME card driving 8 axis.

OPERATOR INTERFACE

Different solutions were evaluated to develop the graphical interface. While MEDM continues to be an effective tool for test and fast prototyping, both LABVIEW and CSS were used to create GUI screens. LABVIEW graphics was developed using the SNS interface library [4]; the result is rather appealing and the solution seems to be robust. We also tested a different approach based on LABVIEW “network shared variable” technology that constitutes a viable alternative to the SNS solution (EPICS client capability has been included in LABVIEW as native feature of DSC since the release 8.6). However, the client tool on which we have mostly focused our tests is CSS [5] a powerful and flexible development environment based on Eclipse. The main advantage of CSS over LABVIEW is the full portability to any operating system on which a JRE is available and, most important, the fact that the system functionality is extensible by means of plugins. A plenty of control widgets is available today for GUI development and the connection to PVs is really straightforward,
making CSS usage as simple as MEDM, with the additional benefits of a modern technology. Among the current functions, CSS includes a new version of Alarm Manager and a number of diagnostic tools (i.e. a PV probe and a data browser for trend and historical analysis).

THE CHANNEL ARCHIVER

The Archiver is the primary tool for storing and retrieving PV data. The Archiver relies on a native “engine” that collects data from the Channel Access and writes them to a built-in database (a set of local files and related indexes) according to a configuration file. The Archiver status and configuration can be monitored through a Web browser; a Java Client application allows retrieving and displaying data from the Database. When operating as standalone application, the Channel Archiver has performance and functionalities adequate for the control system of a small size plant. For larger facilities, or simply when one wants to take advantage of the functionalities of a Relational Database, the Archiver can be used in conjunction with an external RDB: in this configuration, PV data are acquired by the Archiver and copied to the RDB (in our case, we are testing both solutions: the standalone and that based on mySQL).

A considerable effort is being carried out, in collaboration with CSS developers at SNS, towards the integration of Channel Archiver with CSS. In particular we are working on a new version of Alarm Management, implemented as CSS plugin that can retrieve historical and alarm data either from the Archiver in standalone mode or from the mySQL Database.

THE CONTROL NETWORK

EPICS IOCs and PCs used for both client applications and software development communicate over a private network to isolate them from the traffic of laboratory network. The control network implements several services to improve diagnostics and maintenance. Other than the DHCP, DNS and firewall services, it is worthy to mention the installation of a Nagios [6] server, whose function is monitoring the operation of all installed IOCs and dispatching alarms in case of detected malfunction.

Another server provides, for all Linux machines, the automatic installation of the operating system together with the EPICS development environment. A backup server, based on a Network Attached Storage (NAS) device, allows full or incremental backup of control machines.

Finally, a Subversion and Wiki servers are installed to support the development of applications. The Subversion server keeps track of code versions, while the Wiki server is very useful to maintain the documentation on team activity.

CONCLUSION

The control system of Target Laboratory continues to be a test bench for hardware and software technologies that will be used for the SPES facility. Some technical choices have been investigated enough to lead to strategic decisions (i.e. using CSS for GUI and other client applications); other key issues must be studied and tested. One important point is interfacing the PLCs used for safety applications to the EPICS network. We are strongly oriented to use OPC servers on PLC side and the library developed at BESSY [7] to implement the OPC client functionality on EPICS side. Another interesting work is being carried out on Data Bases to be used in conjunction with Archiver. We are considering the possibility of using HyperTable [8] that is free and significantly faster than mySQL. First tests in this direction are very promising.

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