APPLICATION OF PCS IN NSRL CONTROL SYSTEM

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Abstract

The upgrade of the National Synchrotron Radiation Laboratory (NSRL) control system is currently being implemented using EPICS (Experimental Physics and Industrial Control System). For cost saving purposes, we use a large number of PCs. PCs play a dominant role as I/O controllers (IOCs) and device controllers in the new control system. In this paper, the application of PCs in the NSRL control system is described.

1 INTRODUCTION

The NSRL consists of a linac, transport line and electron storage ring. The control system of NSRL was designed in 1983 and completed in 1990. It includes some subsystems such as ring main power supply control, ring correctors power supply control, linac and transport line power supply control, vacuum monitoring, radiation safety monitoring, etc. There is no connection between subsystems and no datasharing. The backbone of the existing system is the main power supply control system. In the main power supply control system, the power supply controller is a MULTIBUS-I based system which is star-networked to the high level computer through opto-coupled RS-422 links. The high level computer is an 80486 PC which is used for both control and operator interface [1].

As a part of the Phase-II project, the upgrading of the NSRL control system started at the end of 1997. The new control system is being implemented via EPICS. For economic and practical reasons, a large number of PCs are used as Operator Interfaces (OPI), IOCs and front-end device controllers.

2 SYSTEM DESCRIPTION

The new control system is based on EPICS, following the standard model. As shown in Fig.1, IOCs connect to OPI via Ethernet. The communication between IOCs and device controllers is realized using opto-coupled RS-422, opto-coupled RS-485 or CAN bus. The system includes the following subsystems:

- ring main power supply control and monitoring.
- ring correctors power supply control and monitoring.
- linac and transport line power control and monitoring.
- vacuum monitoring.
- water system.
- radiation safety monitoring.
- RF cavity control and monitoring.
- closed orbit feedback system.

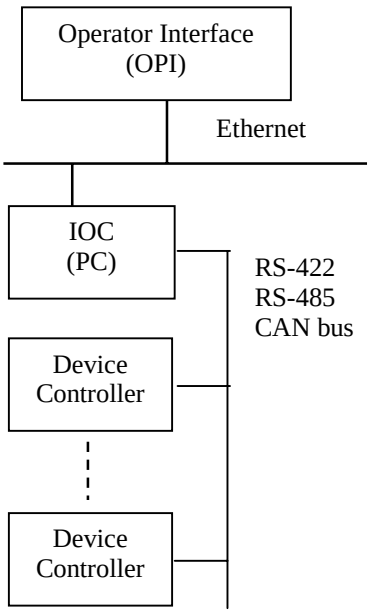

Fig.1 NSRL new control system

In the next sections, PCs used as OPI, IOCs and front-end device controllers will be discussed in detail.

3 OPI

Conventionally, EPICS Operator Interface clients are based upon the Unix/X Window Systems, and also the Wind River System's real time VxWorks operating system. The VxWorks we purchased is based upon Unix. Which make Unix Workstation inevitable. Sun Workstations were used as hosts of VxWoks and OPI of EPICS.

Recently, some EPICS tools (such as MEDM) based on Linux were made available. Thus, PCs running Linux can be used as OPI of EPICS. Since PCs are much cheaper than Unix Workstations, the application of PCs can significantly reduce the development cost.

4 IOCS

As EPICS IOCs, PCs can perform as well as VME-based systems in certain, well-selected situation, such as

interfacing with GPIB, field bus, industrial LANs, industry packs, etc. [2]. In the NSRL new control system, as shown in Fig.1, all EPICS IOCs are based on industrial PCs with a Pentium II 350 CPU.

Fast Ethernet (100Mbits/sec) is used at the network level. An Intel Pro/100+ Ethernet card was added to the IOC crate to provide an interface between the IOC and the network.

PCs as IOCs communicate with the front-end device controllers via ISA/PCI bus communication cards over opto-coupled RS422/485 or CAN bus. For example, in the subsystem of the ring main power supply control and monitoring, the IOC communicates with 12 power supply controllers via opto-coupled RS422 in "point to point" mode [3]. The MOXA's multi-serial card C168P with it speed as high as 115.2kbps is used to expand the IOC serial ports. The operating system of the IOC is VxWorks. Correspondingly the device driver was written to integrate the ports as tty devices.

5 FRONT-END DEVICE CONTROLLERS

Considering the inexpensive price and the support of a large amount of commercially available hardware and software products, most front-end device controllers are employed on industrial PCs with a Pentium II 350 CPU.

In the NSRL new control system, front-end controllers generally face 4 types of signals: Analog Input (AI), Analog Output (AO), Digital Input (DI), and Digital Output (DO). A large amount of high quality commercial IO cards based upon ISA/PCI bus are available. The general front-end controller hardware structure is shown in Fig.2.

The optional operating systems for the front-end industrial PCs are MS DOS, Windows, and VxWorks, etc. Since VxWorks supports multi-tasking, it is preferred, although MS DOS and Windows are more familiar to most people.

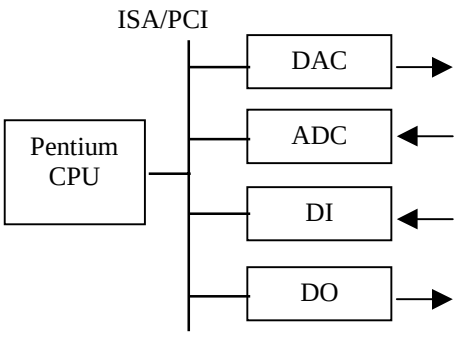

Fig.2 Front-end device controller structure

6 CONCLUSIONS

The use of PCs in accelerator control system is getting more and more popular. The core components of EPICS are now running on PCs, and Wind River System's real time VxWorks operating system based on PC platforms are available. This development will significantly reduce the cost of deploying EPICS systems. There are now several examples of small and medium scale accelerators being controlled exclusively by PCs [4]. The application of PCs in NSRL control system is proven to be reliable and extremely cost effective according the commissioning of the subsystem of ring main power supply control and monitoring, and the subsystem of linac and transport line power control and monitoring.

ACKNOWLEDGEMENTS

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