HLS POWER SUPPLY CONTROL SYSTEM BASED ON VIRTUAL MACHINE

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Abstract

The Hefei Light Source (HLS) is a VUV synchrotron radiation light source. It is upgraded recently to improve its performance. The power supply control system is a part of the HLS upgrade project. Five soft IOC applications running on the virtual machine are used to control 190 power supplies via MOXA's serial-to-Ethernet device servers. The power supply control system has been under operation since November 2013, and the operation results show the power supply control system is reliable and can satisfy the demands of slow orbit feedback with the frequency of 1Hz.

INTRODUCTION

The Hefei Light Source (HLS) is a VUV synchrotron radiation light source. It is upgraded recently to improve its performance. As a part of the HLS upgrade project, all the power supplies are rebuilt, and the power supply control system is correspondingly reconstructed.

There are 190 power supplies totally. They are divided into about ten types, and used for dipole magnet, quadrupole magnet and sextupole magnet, etc. All these power supplied are designed with the unified control interface. Five soft IOC applications running on the virtual machine are used to control these power supplies via MOXA's serial-to-Ethernet device servers.

The power supply control system has been under operation since November 2013, and the operation results show that the power supply control system is reliable. The communication time is less than 50 ms, it can satisfy the demand of the slow orbit feedback with the frequency of 1Hz.

HARDWARE

The power supply control system is developed under EPICS environment, its hardware structure is shown in Figure 1.

Five softIOCs are running on the virtual machines, which is built with VMware. They communicate the power supplied via MOXA's serial-to-Ethernet device servers Nport 6650-16. All the power supplies has the unified interface, i.e. serial port with plastic fibre connection, the baud rate is 115.2kbps. A photoelectric converter with 16 ports is specially designed for MOXA Nport 6650-16, and is used between the serial device servers and the power supplies.

All the IOC applications are put on a NFS server, each softIOC is used as NFS client to share the IOC applications.

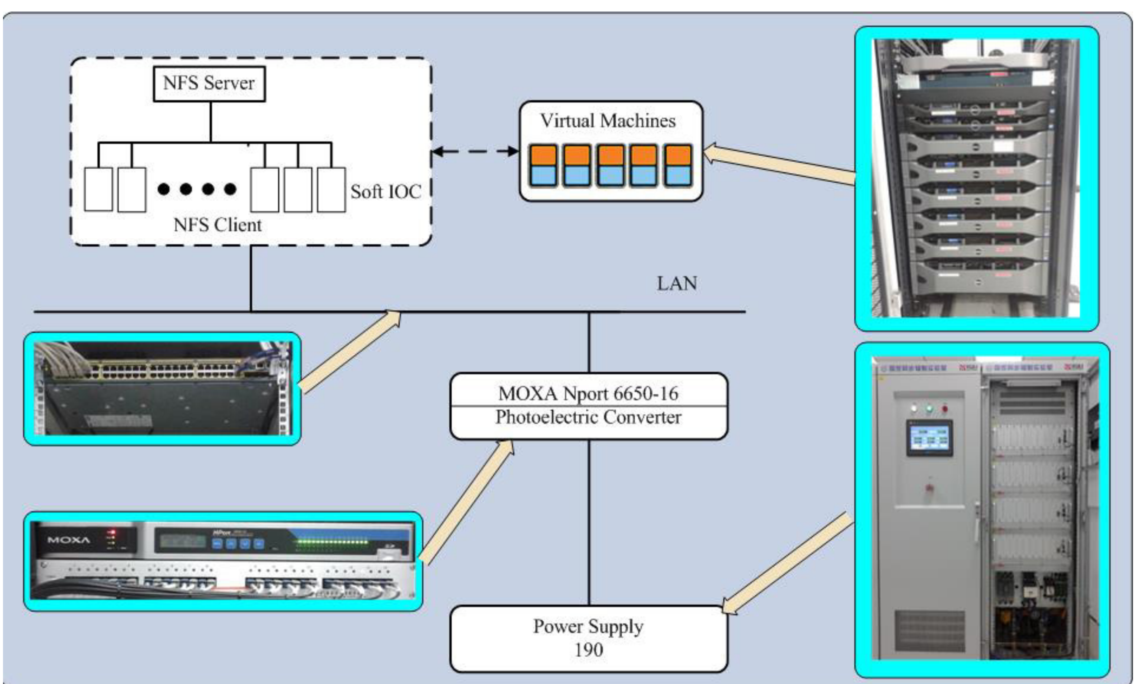

Figure 1: Hardware structure of power supply control system.

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SOFTWARE

Figure 2 shows the software structure of the HLS power supply control system. The softIOC and OPI are all running under Linux environment.

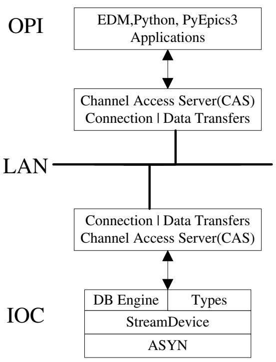

Figure 2: Software structure of the HLS power supply control system.

The module StreamDevice [1] and ASYN [2] are the interface between the softIOCs and the power supplies. The communication protocol is customized, it's an ASCII protocol with check sum. The module iocStats [3] is used to monitor the status of softIOC, and the module autosave [4] is used to support bumpless IOC reboot.

The human machine interface is developed with EDM [5], as shown in Figure 3. The setting is saved/restored with PyEpics3 [6].

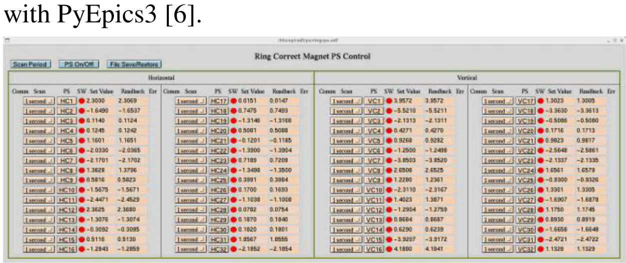

Figure 3: OPI of the HLS ring correct magnet power supply control system.

PERFORMANCE

Among the HLS power supplies, the ring correct magnet power supplies are dynamic with 1Hz feedback frequency. So the respond time of the control system is the key parameter. There are 64 correct magnet power supplies totally, each half is for horizontal or vertical slow orbit feedback.

The respond time is tested with Wireshark, which is running on the softIOC. The softIOC sends consecutively the command of current setting to 32 correct magnet power supplies with 1Hz frequency. The test lasts for about 1080 seconds. Figure 4 is the application screen of Wireshark. The data obtained by Wireshark are analysed and the results are shown in Table 1. The time from the 1st sent package to the 32th received package is less than 50ms, it can satisfy the demand of the slow orbit feedback with the frequency of 1Hz.

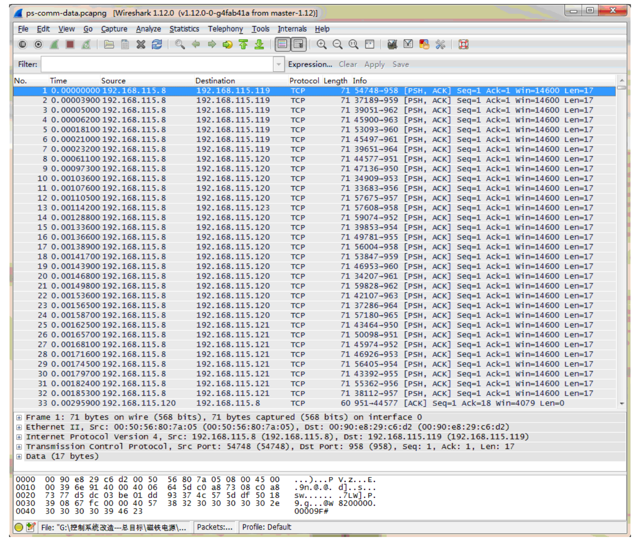

Figure 4: Application screen of Wireshark.

Table 1: Response Time Statistics

Time	Min.(ms)	Max.(ms)	Aver.(ms)	Std.(ms)
T1*	0.634	6.247	1.416	0.483
T2**	36.733	45.852	40.235	1.287

*T1: the time from the 1st sent package to the 32th sent package.

** T2: the time from the 1st sent package to the 32th received package.

The interface of the slow orbit feedback system is shown in Figure 5. The effect of the slow orbit feedback system is shown in Figure 6 and Figure 7.

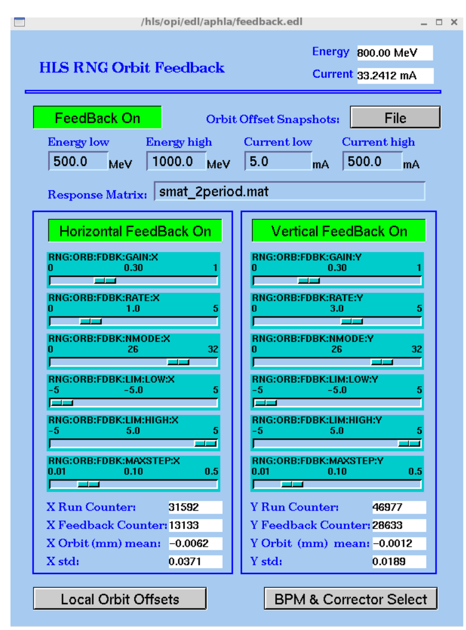

Figure 5: The interface of slow orbit feedback.

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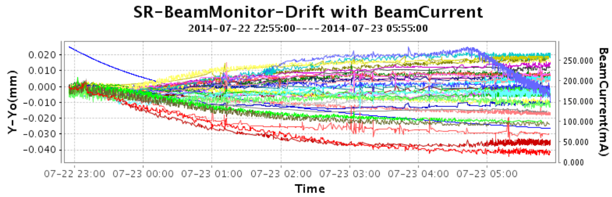

Figure 6: Vertical beam position drift when the slow orbit feedback system is off.

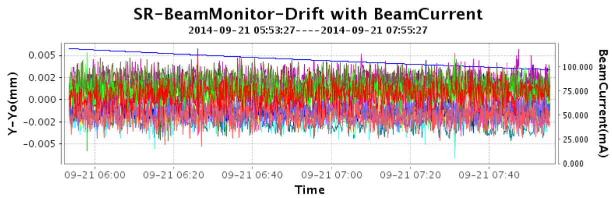

Figure 7: Vertical beam position drift when the slow orbit feedback system is on.

CONCLUSION

All the power supplies of HLS are controlled with the softIOCs on the virtual machine, and Ethernet is used instead of the fieldbus, the communication time is less than 50 ms, it can satisfy the demands of the slow orbit feedback with the frequency of 1Hz.

REFERENCES

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