Power Supply Control Prototype Based on RTEMS

中国科学院高能物理研究所
Institute of High Energy Physics
Chinese Academy of Sciences

H.L.Shi* C.H.Wang J.Y.Tang IHEP, Beijing, 100049, CHINA

INTRODUCTION

The development of accelerator control system based on RTEMS (Real Time Executive for Multiprocessor Systems) is a front research task in international perspective. The prototype uses an open-source real-time operating system -- RTEMS, and applies PSC (power supply controller)/PSI (power supply interface) which were developed by BNL (Brookhaven National Laboratory). The paper introduces the structure of the prototype, testing results with a power supply of a corrector magnet. Now one can switch on/off the power supply, ramp up/down the current, and monitor the real-time states of the power supply using the developed OPI (Operator Interface). With the success of the prototype, it looks to have a good opportunity to apply RTEMS in the control systems of Chinese major accelerators with further developments.

PROTOTYPE HARDWARE STRUCTURE

The prototype uses PC/Linux as the upper computer, PowerPC MVME5500 as the lower computer, and PSC/PSI as power supply controller. Upper computer and lower computer communicate through Ethernet. MVME5500 and a few PSCs reside in the same VME crate, and communicate with each other by VME bus. PSC and PSI connect with fiber optic cables (one for receiving data, and the other for sending data). PSI and power supply connect with two cables (one for analog signal, and the other for digital signal). When powering on, lower computer will download RTEMS kernel from upper computer into MVME5500 through Ethernet, and then RTEMS operating system starts. One can download PSC/PSI drivers and EPICS databases by cexp prompt, and control, monitor power supply by OPI. Hardware structure is shown in figure 1:

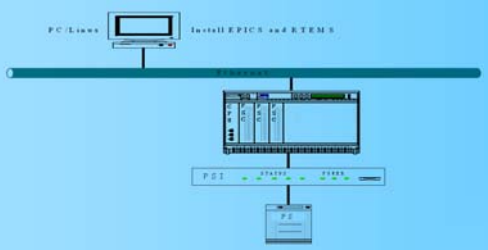

figure1: prototype hardware structure

PROTOTYPE SOFTWARE STRUCTURE

The prototype develops OPI with EDM. RTEMS kernel, EPICS databases and PSC/PSI drivers are downloaded into lower computer through Ethernet. EPICS databases and OPI communicate by EPICS CA. Software structure is shown briefly in figure 2:

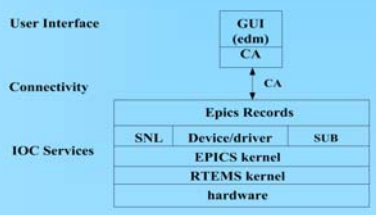

figure2: prototype software structure

TESTING RESULTS

The prototype uses PC/Linux as the upper computer, PowerPC MVME5500 as the lower computer. On the upper computer, RTEMS is installed, EPICS base 3.14.6 compiled, and OPI developed, and then debug with a corrector power supply.

✓ **Download RTEMS kernel**

When the lower computer powers on, one can download RTEMS kernel into it, RTEMS starting process is shown in figure 3:

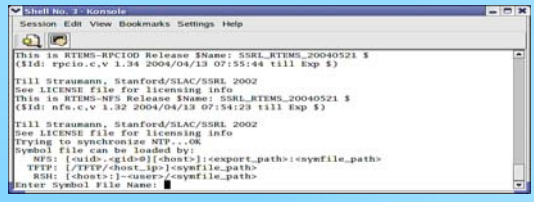

figure3: RTEMS starting process

✓ **Download .dbd, .db, drivers etc**

After RTEMS starts, it will look for the file named st.sys, and executes the commands in the file. As figure 3 shows, RTEMS will ask for the path of st.sys. When inputting the path, press "return", .dbd, .db, drivers files will be downloaded into the lower computer. Successful downloading process is shown in figure 4:

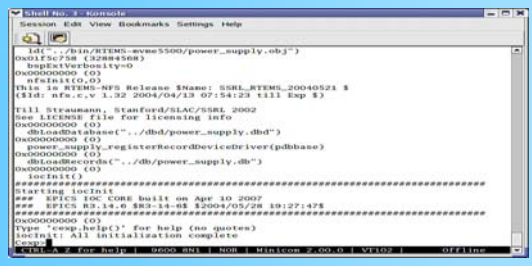

figure4: EPICS application downloading process

✓ **Establish OPI**

In the prototype, power supply is controlled by OPI. Figure 5 shows such values as feedback, current, and some status values when power supply current ramps up to 1A.

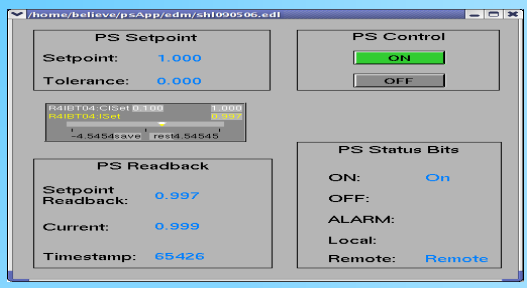

figure5: prototype hardware structure

CONCLUSION

The paper introduces power supply control prototype based on RTEMS and testing results with a power supply of a corrector magnet. The author built the cross-compile toolchain based on RTEMS and PowerPC structure, modified the driver successfully, and drivers can run on RTEMS on the lower computer. Now one can control and monitor the power supply with OPI.

ACHNOWLEDGEMENT

Sheng Peng gave me a lot of help in building cross-compile toolchain and modifying PSC drivers. S.Kate Feng from NSLS helped me a lot in building the EPICS application and RTEMS kernel. Till straumann from SLAC helped me a lot in RTEMS functions usage, RTEMS kernel and RTEMS debugging. Here, I'm really very thankful to all of them.

* shl@ihep.ac.cn, work on embedded OS study such as VxWorks and RTEMS