POWER SUPPLY CONTROL PROTOTYPE BASED ON RTEMS*

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Abstract

The development of accelerator control system based on RTEMS (Real Time Executive for Multiprocessor Systems) [1] 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. One can switch on/off the power supply, ramp up/down the current, and monitor the real-time states of the power supply with the developed OPI (Operator Interface).

INTRODUCTION

EPICS (Experimental Physics and Industrial Control System) [2] is widely used to establish control system in the accelerator field in the world. Early version of EPICS is developed based on VxWorks. EPICS international collaboration group is devoted to support RTEMS, which is a source-open and free operating system, and extends RTEMS into EPICS newer version 3.14. A few laboratories in USA have successfully applied RTEMS into control system based on EPICS, while it's the first time to use RTEMS in accelerator field in China. The paper introduces a power supply control system prototype based on RTEMS. The prototype is composed of upper computer PC/linux, VME-based lower computer PowerPC MVME5500, and PSC/PSI module developed by BNL. Our goal is to establish power supply control system based on RTEMS in place of commercial and expensive VxWorks.

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)[3]. When powering on, lower computer will download RTEMS kernel from upper computer into MVME5500 via Ethernet, and start RTEMS operating system. One can download PSC/PSI drivers and EPICS databases by cexp prompt, and control, monitor power supply with OPI. Hardware structure is shown in figure 1:

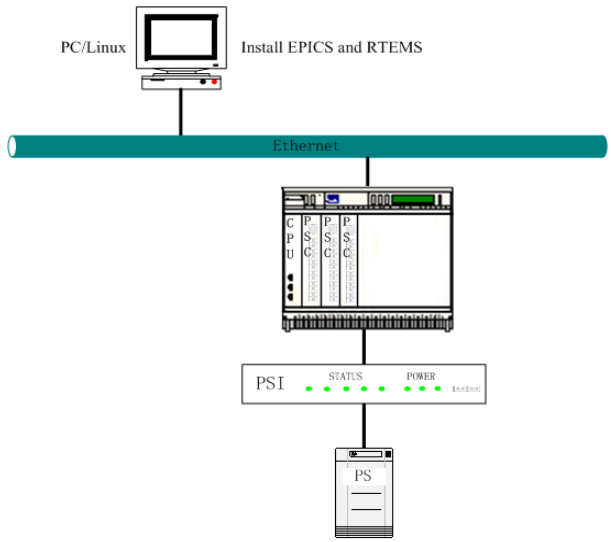

Figure 1: Prototype hardware structure.

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 in figure 2:

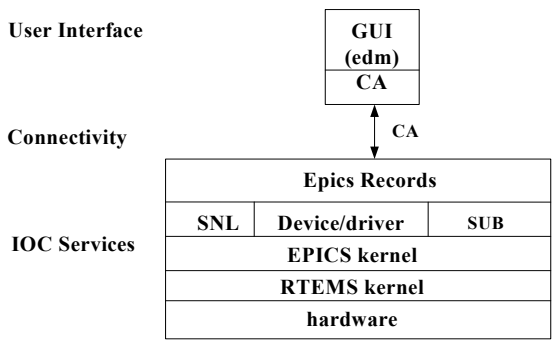

Figure 2: Prototype software structure.

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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

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

- Download .dbd, .db, drivers etc

After RTEMS starts, it will look for the file named st.sys, and execute 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[4]. Successful downloading process is shown in figure 4:

- 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.

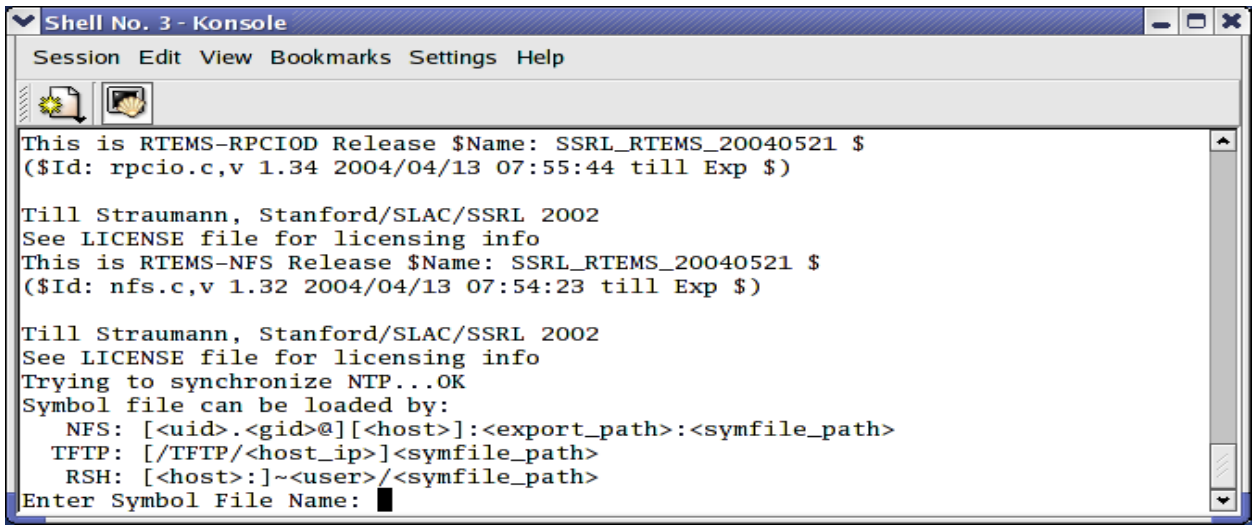

Figure 3: RTEMS starting process

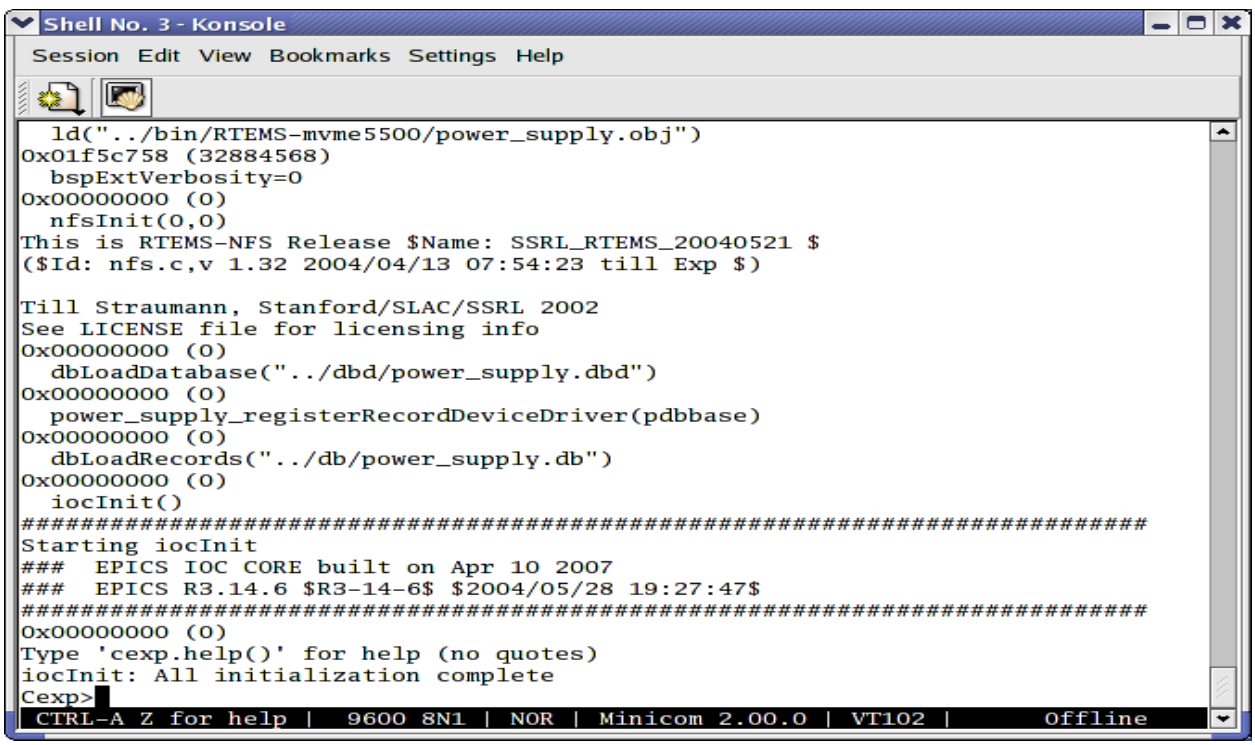

Figure 4: EPICS application downloading process.

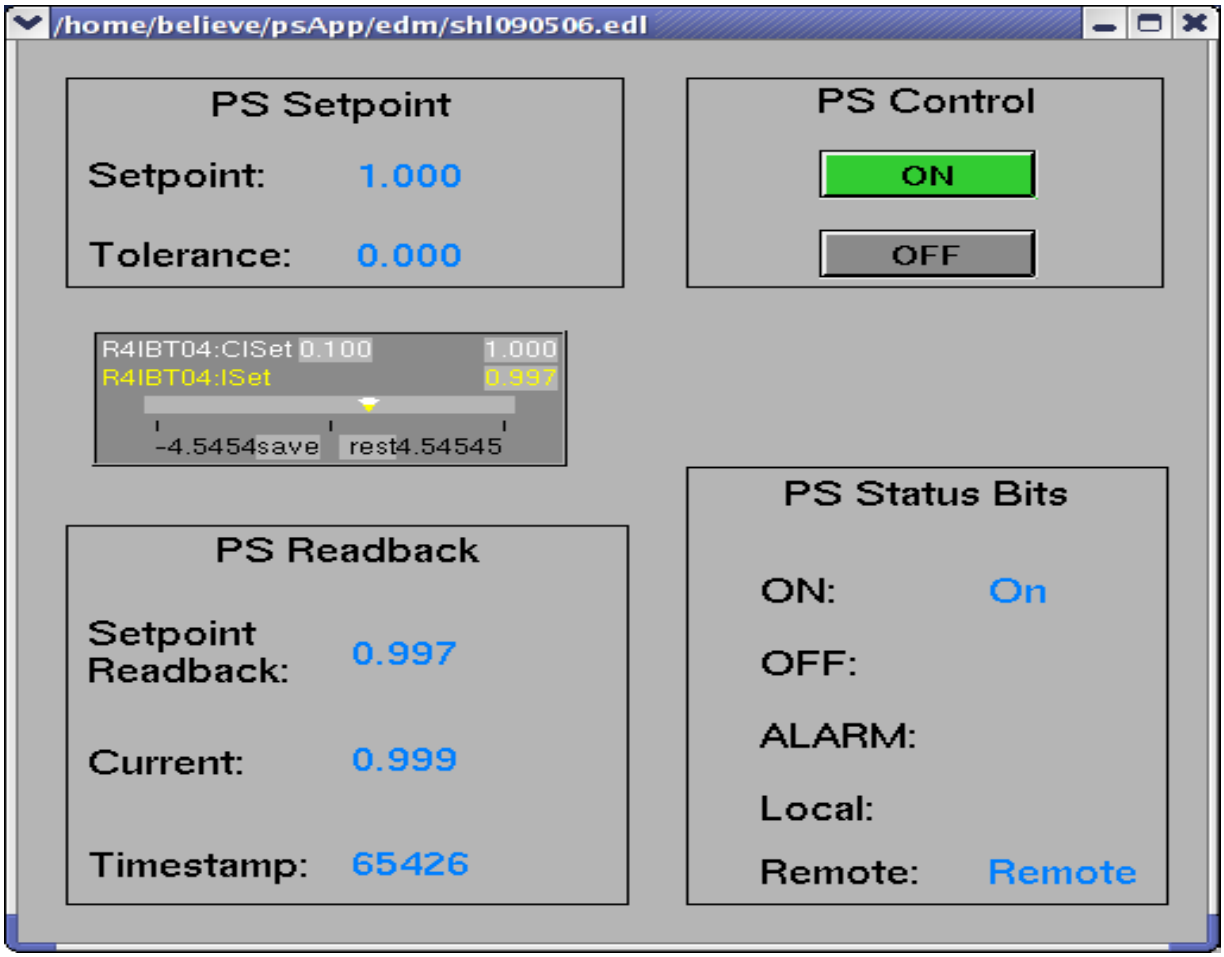

Figure 5: Prototype OPI.

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. Drivers can run on the lower computer. Now one can control and monitor the power supply by OPI.

ACKNOWLEDGEMENT

Peng gave me a lot of help in building cross-compile toolchain and modifying PSC/PSI 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 building and programs debugging. Here, I'm very thankful to all of them.

REFERENCES

[1] www.rtems.com.
[2] www.aps.anl.gov.
[3] Chunhong Wang, Xiaoli Wang, et al. "BEPCII magnet power supply control system", high energy physics and nuclear physics, 31(1) ,2007.
[4] S. Kate Feng, "EPICS/RTEMS at NSLS", EPICS Meeting at DLS, UK, June 19, 2000.