THE EPICS PROTOTYPE WITH IOC ON LINUX PLATFORM

Shifu Xu, Jijiu Zhao, IHEP, Chinese Academy of Sciences
P.O.Box 918(10), Beijing 100039, P.R.China

Abstract

The Experimental Physics and Industrial Control System(EPICS) has been widely used in the particle accelerators. Traditionally, the Input Output Controller(IOC) of EPICS runs on vxWorks based on VME processors or PCs platforms. Recently, the new EPICS release base 3.14 supports iocCore on platforms besides vxWorks. This paper describes the hardware and software of EPICS prototype system with IOC on Linux x86 platform. It also discusses the prospect of EPICS on Linux platform.

1 INTRODUCTION

As a non-commercial SCADA toolkit, the EPICS, which was originally developed by LANL and ANL, is now widely used in the particle accelerators. Now more and more institutes join the international collaboration for developing the EPICS. The EPICS consists of a set of software components and tools with which application developers can create a control system[1]. The basic components are:

- OPI : Operator Interface. This is a UNIX based workstation which can run various EPICS tools.
- IOC : Input Output Controller. This is VME/VXI based chassis containing a Motorola 68xxx processor, various I/O modules, and VME modules that provide access to other I/O buses such as GPIB.
- LAN: Local area network. This is the communication network which allows the IOCs and OPIs to communicate. EPICS provides a software component, Channel Access, which provides network transparent communication between a Channel Access client and an arbitrary number of Channel Access servers.

The BEPC will be upgraded to the BEPCII with higher luminosity in the next 3 to 4 years. The BEPCII consists of a 1.55~1.84GeV linac accelerator, two transport lines and a 1~2.8GeV storage ring[2]. To reach the goal of the BEPCII, the current control system should be upgraded. The BEPCII control system will adopt a distributed architecture, called “standard model”. Logically, the system is structured with three levels, which are presentation layer, process control layer and device interface layer. With regard to the software development environment, the EPICS is the primary alternative. it is Not only non-commercial and open source, but also a lot of applications for accelerator commissioning and operating can be shared and it is easy to get technical support from many HEP institutes in the world.

Traditionally, the IOC of EPICS runs on vxWorks based on VME processors or PC platforms. Recently, with the OSI (operating system independent) library, which isolated all operating system differences behind a standard interface which can be re-implemented for each operating system, the new EPICS release base 3.14 supports iocCore on platforms besides vxWorks. IocCore is now supported on the following platforms[1]:

- vxWorks, Tornado II is required.
- RTEMS, an open source real time operating system. It has been tested on MVME167 and MC68360 processors. RTEMS also supports powerPC.
- Solaris, it has been tested on solaris 2.6 and solaris 8.
- Linux, it has been tested on Redhat x86 platforms.
- winNT

The fact that iocCore can run on multi-OS will really lower the barrier for EPICS since vxWorks isn't needed for the non-demanding applications. The basic crate and controller can be a bare bones PC box up to a high-end CompactPCI system.

With the growing development of Linux, it gradually becomes one of the most important operating systems. Because of its open source characteristic, Linux is now widely supported. Considering the progress of Linux and the trend toward Linux, it is encouraging to build the EPICS prototype on Linux platform. The following sections will discuss the hardware and software of the EPICS prototype on Linux platform.

2 HARDWARE

As a presentation layer, OPI should provide a friendly graphical man-machine interface, so that the operator can control and monitor the accelerator equipment from the consoles. As a process control layer, IOC provides distributed processing and concentrates the control activities of sets or assemblies of equipment or entire sub-processes. The OPI and IOC could be on a single computer or on a different computer, respectively. Thus, the hardware structure of EPICS could be simple or complex. First, we have built a simple system that the OPI and IOC are located on the same PC, so that the system becomes a cost-effective solution. In this case, we build the simple prototype with the following components: a x86 PC with a 600MHz Celeron processor running on Redhat 7.1 Linux platform; PC6310: ADC card providing up to 100kS/s sampling rate, 12-bit resolution performance on 32 single-ended or 16 differential channel analog inputs. This ADC adapter is

used to test some of EPICS functions.

Some tests have been done when OPI and IOC are located on the different machines and EPICS system also works well.

3 SOFTWARE

The lastest EPICS release 3.14 is the first release that supports iocCore on non vxWorks. The iocCore has made a lot of changes compared with the previous ones. One of the important changes is adding OS independent layer to support port of IOC core. The port is based on the following assumptions[3]: All hardware support will be built separately. Thus it does not need to be ported. IocCore requires a multithreaded environment.

Some vxWorks proprietary and EPICS-related libraries are replaced by OSI libraries. The software architecture of EPICS based on Linux platform is showed as Fig1:

3.1 system software

Presently Redhat Linux 7.1 is adopted as the prototype platform. It is standard Linux providing soft real time only. It may mostly work well and it may be supposed to work in non time-critical circumstances. Development teams all over the world are making some modifications to the Linux kernel in order to provide a hard real time operating system. To the present time, there are already several hard real-time Linux coming forth. The comparison of these Linux is beyond the scope of this paper. One of them will be opted for as the OS platform to evaluate the EPICS. It's hoped that the EPICS could work well on hard real time Linux.

3.2 EPICS-related software

3.2.1 Database record

In the current prototype, several conventional EPICS records are used to access the ADC card. They are ai and calc records. The ADC device support routine is developed to support ai record support routine . In the next prototype, several profibus-related records and relevant device support and device driver support routines will be developed.

3.2.2 OPI tools

DM2K is chosen to be graphical human machine interface and it's very popularly used in EPICS community and allows one to create powerful console applications with minimum efforts. It is available under Unix, Linux and Windows NT. It is tried under Linux and Unix, and it works well. It will be tried under Windows 98/NT. Other tools such as ALH, SNL, AR are to be evaluated too in the near future.

A few console DM2K-based applications were designed. All the information about the application screen and connections to IOCs is stored in the description file .adl. One file testADC.adl is designed to test ADC card. Another file testADC_DAC.adl is designed to simulate ADC and DAC function. These files can be used on different platforms without any changes.

The example screen of testADC_DAC.adl under Linux is presented as Fig2:

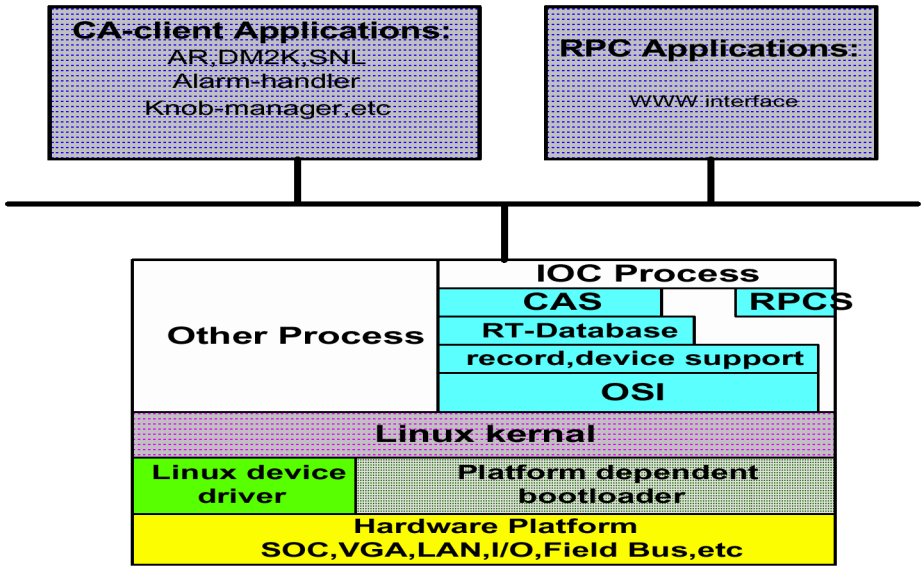

Fig.1: Software architecture of EPICS on Linux

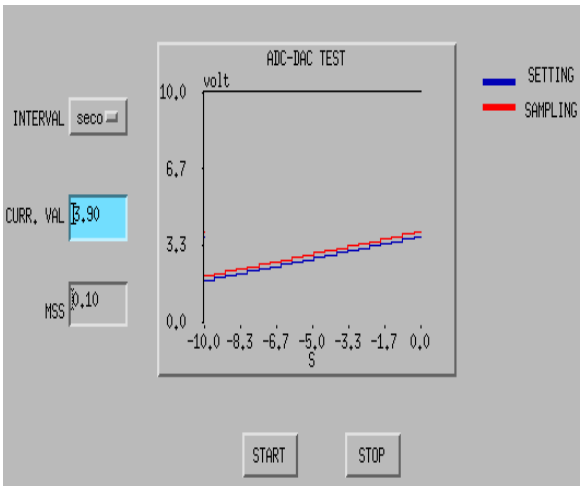

Fig.2: The example OPI interface using DM2K

4 FUTURE PLAN

Recently we have done the first step for EPICS system with Linux IOC. In our next step, we plan to evaluate some of the OPI tools and IOC functions, such as AHL, AR,SNL etc. And later on we will develop a profibus device driver and do some test under this system.

5 CONCLUSION

Some of the EPICS function and tools are evaluated under PC platform with Linux EPICS IOC. As known to us all, PC platform has its obvious advantages. It is cost effective and develops very quickly. At the same time, Linux has free and open source code. It is more and more robust and reliable. Like VxWorks, Linux kernel can also be scalable for target. The EPICS system with IOC on Linux platform is a promising control system at least in non time-critical environments and it could be adopted in real time envionment and large scale control system in the near future. Several hard real time Linux are being developed under which EPICS IOC need to be evaluated. EPICS IOC on Linux also need to be consummated.

REFERENCES

[1] http://www.aps.anl.gov/epics/
[2] http://www.ihep.ac.cn/bepc2/
[3] M.Kraimer et.al.,"EPICS: Porting iocCore to Multiple Operating System", ICALEPCS'99 ,Trieste, Italy, Oct.1999.