

MINIEPICS - AN EPICS PACKAGE FOR SMALL ACCELERATORS/EXPERIMENTS

Guobao Shen*, Norihiko Kamikubota, Junichi Odagiri, Noboru Yamamoto, Kazuro Furukawa,
Tadahiko Katoh

High Energy Accelerator Research Organization (KEK), Tsukuba, 305-0801, Japan

Abstract

EPICS is a control software tool-kit, which was developed for large accelerators. The original EPICS assumes to use VME-bus computers and a commercial license of a real-time operating system (VxWorks). However, after the version of EPICS 3.14.1, which was released in 2002, it can run on many operating systems. We are developing a customized EPICS package for small-scale accelerators and experiments, miniEPICS. In this paper, we report on the development status of miniEPICS.

INTRODUCTION

EPICS (Experimental Physics and Industrial Control System) [1, 2] is a software development tool-kit for distributed control systems, which was co-developed by Los Alamos National Laboratory and Argonne National Laboratory. It comprises an amount of software tools and components. With EPICS, application developers and designers can construct an extremely flexible control system, which can minimize the need for custom coding and help to ensure uniform operator interfaces.

Usually EPICS can be divided into IOC (Input Output Controller) and OPI (Operator Interface) parts (see Fig. 1). IOC is a platform that originally assumes to use a VME front-end computer as the hardware and VxWorks⁽¹⁾ as the underlying target real-time operating system. OPI is a workstation that can run various EPICS tools. Most important OPI tools are used to monitor and control IOC as MMI (Man Machine Interface).

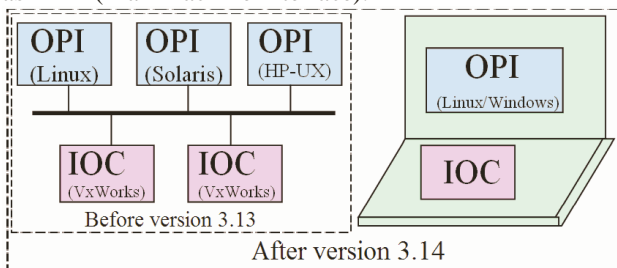


Figure 1: EPICS Architecture.

However, from the version of EPICS 3.14.1[3], which was released in 2002, an OSI (Operating System Independent) [4, 5] layer was introduced into the EPICS target software (iocCore), which completely encapsulated the operating system-dependent functions and resource. With the OSI layer, the iocCore can run on various desktop systems, such as Linux, Solaris, HP-UX, Darwin

and Windows. This means that from EPICS 3.14.1, the IOC and OPI can run on the same computer (see Fig. 1).

EPICS has been used in many large-scale accelerators and astronomical observatories for many years, and has demonstrated high reliability, stability and flexibility. However, it is not easy to introduce EPICS into small-scale accelerators and experiments.

One of the reasons is that the initial cost (especially for VxWorks and VME-bus computers) is considerably high for small groups.

Another reason is that information for beginners is not sufficient. (a) There are many reference manuals for professionals, but not so many documents for beginners. This forces a beginner to spend too much time to understand “what is EPICS”. (b) Another problem is that there are too many tools with no selection guidance. Usually a beginner is confused, and does not know which tools should be chosen. Moreover, because the necessary tools should be installed one by one, the installation procedure is time consuming. As a result, those who wish to start with EPICS always need the help of EPICS experts.

Considering the situations mentioned above, we decided to develop a customized EPICS package, “miniEPICS”, for both beginners and small-scale accelerators or experiments.

MINIEPICS

What is miniEPICS?

miniEPICS is a customized EPICS package, which includes minimum EPICS tools, good examples and introduction documents. It aims at a small-scale system (accelerator and physics experiment), and can be used for the self-study of EPICS.

The basic ideas of miniEPICS are as follows:

- Start from one Linux PC and should be extendable.
- Use PLC⁽²⁾ with a network interface as minimum I/O.
- Contain basic tools (MEDM, VDCT, etc.) only.
- Include good documents and samples for beginners.

In addition, we have a plan to make an installation CD of miniEPICS. A beginner should be able to install stand-alone EPICS without the help of experts. The iocCore can run with dummy signals immediately after installation. With tuning up the configuration files of IOC database, it can run for real I/O signals of example PLCs.

Tools and components

At present, we selected REDHAT 9.0 as the operating system for both IOC and OPI. In the future, we will allow

*e-Mail: <shengb@post.kek.jp>

⁽¹⁾ VxWorks: a commercial real-time operating system by Wind River Co. Ltd.

⁽²⁾ PLC: Programmable Logic Controller (see Fig. 3)

Fedora Core 3 and Windows with the Cygwin [6] environment. The OPI tool is MEDM (Motif Editor and Display Manager) [7], one of the EPICS GUI editors. The data logger is Channel Archiver [8]. The IOC database configuration tool is VDCT [9] provided by CosyLab Company. A network-based device driver [10, 11] (NetDev), which was developed in KEK, is included in order to use PLCs as I/O interfaces. All of the components that will be included into the miniEPICS package are listed in Table 1.

Table 1: miniEPICS package

	Development (2004-2005)	Next version (2005-2006, plan)
OS	REDHAT 9.0 (EPICS 3.14.4)	Fedora Core 3 Windows + Cygwin
OPI /tools	MEDM - GUI editor Channel Archiver - data logger VDCT - Database Tool	EDM - extensible GUI editor Epics.dll (W32API) ALH - alarm handler
OPI /lang		Java (jca) Python
IOC /drv	NetDev - PLC(Yokogawa)	NetDev - PLC(MelsecQ,Omron) CC/NET - CAMAC modules LAN/GPIB

Network Device and Extendibility

miniEPICS uses NetDev as the IOC software. Though NetDev supports many network-based devices, the present development assumes to use FA-M3 PLC [12] by Yokogawa Electric Company.

Network devices cannot ensure good real-time performance (for example 1ms). Thus, in general, network devices are not good (or at least carefully introduced) for accelerator controls. However, for small-scale systems, it might be possible to design the control system to put real-time implementations in the local devices (like PLCs). Network devices are used only for slow data transactions. In this case, we can take advantage of the extendibility of the network and the cheapness of the network equipment.

With miniEPICS, those who wish to construct a control system for a small-scale accelerator can evaluate EPICS, first with one PC and one PLC. Since network-based devices have excellent extendibility, the control system can be extended to a real small-scale accelerator by simply increasing the number of PLCs. Increasing the number of OPIs is easy. It is also possible to monitor the accelerator devices from a remote room by using another OPI, unless a network is unavailable.

STATUS

The idea of miniEPICS was proposed by one of authors (N. K.) at the EPICS 2010 workshop in October, 2003. In February, 2004, an internal web-page for EPICS installation started. In the summer of 2004, some

experiences were acquired concerning RF GUN control in the ATF building at KEK [13]. After the autumn of 2004, we demonstrated a minimum EPICS system with one PC and one PLC [14]. We expect that the pre-release version of miniEPICS will be ready by the fall of 2005.

Most miniEPICS developers are also engaged in the development of an EPICS control system for the J-PARC project [15]. We are preparing some documents to introduce how to use EPICS for those with few EPICS experiments. Fortunately, there are many EPICS-related documents at KEKB. Those documents contain many parts that can be diverted to the introduction documents to be included in miniEPICS. We expect that it will speed up the document preparations for miniEPICS.

DEMONSTRATION

A demonstration kit of miniEPICS has been developed, which consists of one notebook PC and one PLC. The system configuration is illustrated in Fig. 2.

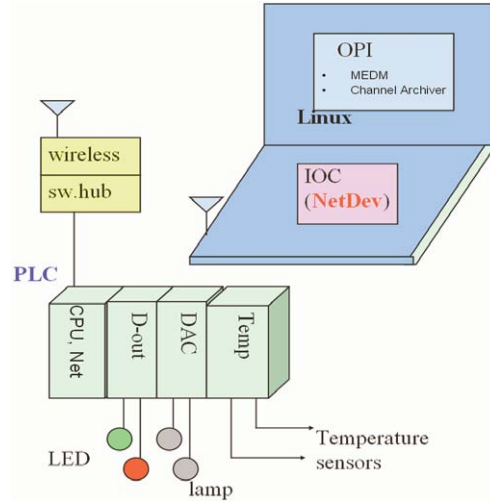


Figure 2: Layout of the miniEPICS demonstration kit.

The network device is a FA-M3 PLC, which includes 3 I/O modules (see Fig. 3):

- Digital output (D-out) module connected to 2 LEDs.
- DAC output module connected to 2 lamps.
- Temperature module connected to 2 temperature sensors (thermal coupled sensor).

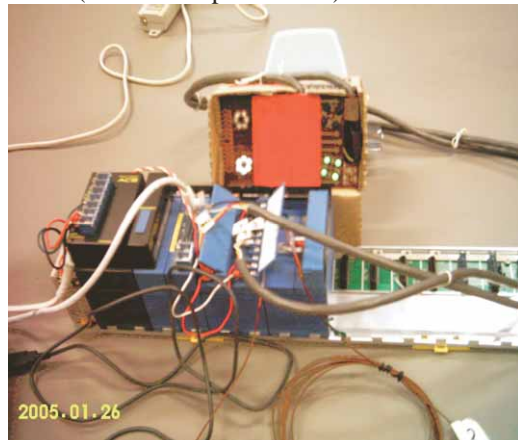


Figure 3: PLC I/O modules for a demonstration.

On the notebook PC, where the REDHAT 9.0 operating system is used, an EPICS IOC (iocCore), an OPI tool MEDM (see Fig. 4), and an OPI tool Channel Archiver (data logger) are running. The IOC software uses NetDev. PLC signals are taken into EPICS via IOC (NetDev).

The control panel was developed with MEDM. The LED (D-out) and lamp (DAC) can be controlled from this control panel (Fig. 4). Temperature sensors, together with a 60-second trend graph, can be monitored by the same panel.

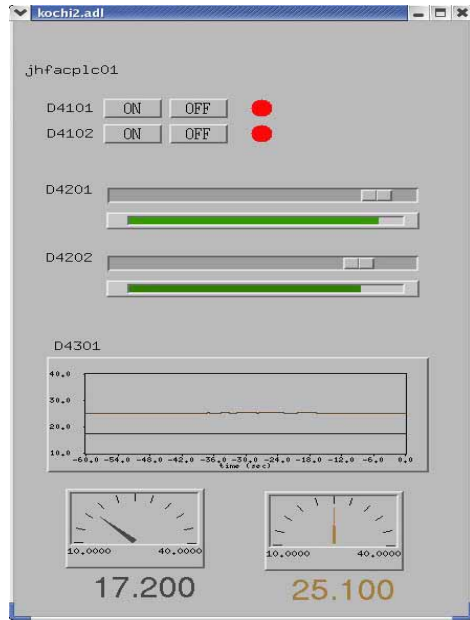


Figure 4: Control Panel of demonstration.

The Channel Archiver is capable of logging various data. In Fig. 5, 3-hour histories of the temperatures are shown. The history data can be browsed by a web browser (see Fig. 5).

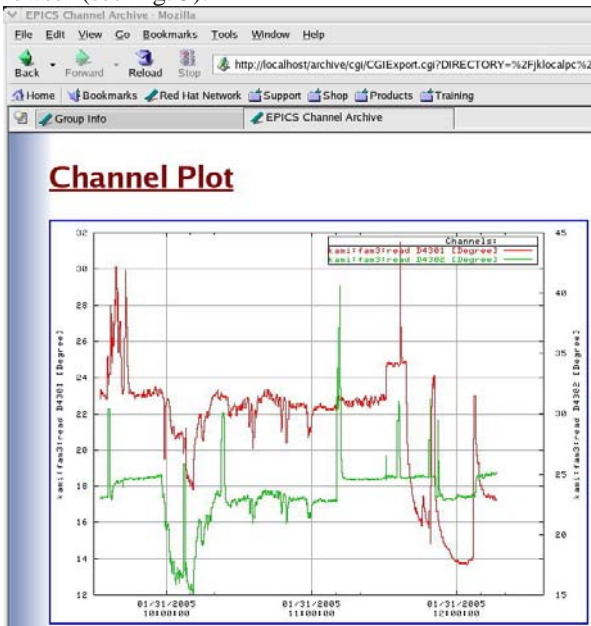


Figure 5: History data browsed by a web browser.

In this demonstration, it is worth noting that everything runs on one notebook PC without VxWorks and a VME-bus computer, which are inevitable for older EPICS versions.

CONCLUSION

Originally, EPICS was designed to run on VME-bus computers using VxWorks as the target operating system. With the release 3.14, EPICS introduces an OSI layer into the EPICS target iocCore, which can allow an IOC to run on various operating systems, including Linux. Introducing EPICS into small-scale accelerators and experiments has become easier than before.

At KEK, a study of a customized EPICS package, "miniEPICS", which aims at both EPICS beginners and small-scale systems, has started. A demonstration with one PC and one PLC succeeded.

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