

# CONSTRUCTING A DISTRIBUTED DEVELOPING ENVIRONMENT USING EPICS FOR BEPCII CONTROL SYSTEM

G. Lei, C. Wang, Z. Zhao, K. Yue, S. Huang, J. Zhao, IHEP, Beijing, China

## Abstract

The current Beijing Electron Position Collider (BEPC) is going to be upgraded to reach a higher energy as 1.89 GeV and a luminosity of  $1.0 \times 10^{33} \text{cm}^{-2}\text{s}^{-1}$ . A second storage ring will be installed in the same tunnel of BEPC. The control system of BEPCII will be constructed based on EPICS. During the past two years a basic prototype has been set up, including 2 Solaris workstations, a Linux PC and MVME2431 CPU boards. EPICS 3.13.4 has been installed and upgraded to 3.13.8. Upon this scalable prototype a distributed computing environment is under construction, to support the commissioning software development and kinds of subsystem development. The efforts of setting up the EPICS based prototype will be introduced in this paper. The methods of constructing a distributed host environment for BEPCII control system will be discussed.

## INTRODUCTION

The Beijing Electron-Position Collider (BEPC) was constructed for both high energy physics and synchrotron radiation researches. The BEPC accelerators consist of a 202-meter's long electron-position linac injector, a storage ring with a circumference of 240.0 meters, and transport lines with the total length of 210 meters. [1]

BEPCII is an upgrade project of BEPC aiming at the luminosity of  $1 \times 10^{33} \text{cm}^{-2}\text{s}^{-1}$  at 1.89 GeV. It consists of 2 rings with electron and positron circulating in each separate storage ring while colliding at the common interaction point. The two rings are accommodated in the existing BEPC tunnel. [2]

The control system of BEPCII will be constructed using EPICS and adopt a distributed architecture. [3]

## EPICS FOR BEPCII

In 2001 a mini EPICS environment was set up for the preliminary design of BEPCII. That environment included a Solaris workstation Ultra-10, MVME 2431. EPICS base 3.13.4 and vxWorks 5.4.2 were chosen. The original Solaris 2.6 was upgraded to Solaris 2.8 in the summer of 2002.

### Tools Built

EPICS base 3.13.4 and most of the extensions have been compiled. Simple applications have been built to practise some of the often-used tools, such as:

- MEDM, dm2k and EDM. All of these tools are welcome and EDM is more preferred in our group.
- Database configuration tools VDCT and Capfast.
- Striptool. Figure 1 shows a example using Striptool.

- Probe: to debug database records.
- Alarm handler ALH

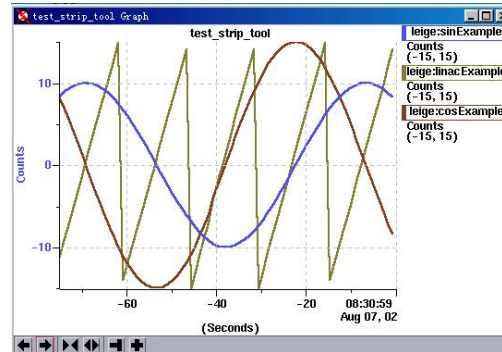


Figure 1: Application using Striptool

Besides EPICS, some third-party software have been installed [4], either to support the compiling and linking of EPICS, or to enlarge the ability of OPI for the system, such as Python, Tcl/Tk and Gnuplot. Figure 2 shows an example using Gnuplot to display the data archived by Channel Archiver from the running of excas.

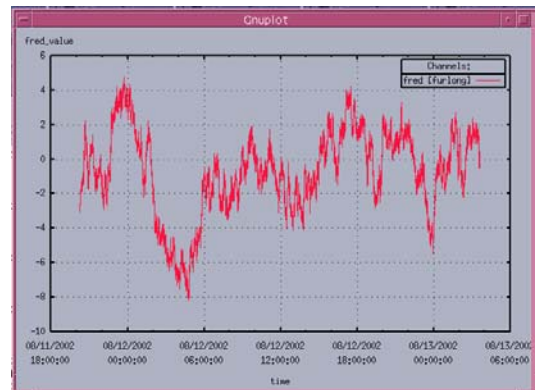


Figure 2: Example of using Gnuplot

## Compiling Extensions

Some parameters in makefiles have been re-configured while compiling the extensions, to specify the location of kinds of libraries in our system, tools used, versions of tools, and so on.

- For dm2k and MEDM, parameters in the makefiles have been set to use JPT, instead of XRT or SciPlot.
- Some commercial software packages such as XPM and Pure have not been bought in our group so the lines for using these tools in the makefiles have been commented out
- Small patches were made to compile Channel Archiver in Solaris 2.8.

## Linking

When compiling and linking EDM, the executable file generated using the `ld` utility provided by Solaris 2.8 could not run correctly. So we installed and use the GNU binary utilities, which include `ld`, `as`, `ar`, `nm`, `ranlib` and others. Satisfying results have been gained on using EDM.

## Applications

45 user accounts have been created. Supports to the users are provided whenever it is needed.

Driver support programs and applications for the subsystem control have been built using the EPICS environment.

## EPICS Base Upgraded to 3.13.8

A decision has been made to use the highest version of the EPICS base 3.13.x, so in April 2003 the base were upgraded from 3.13.4 to 3.13.8, which is the up-most version of 3.13.x at that time. This work was done very carefully so as not to disturb the application developing of the subsystems.

## FILE SERVER

The second Solaris workstation for storage ring control of BEPCII was ordered and shipped to IHEP in January 2003. Then the file server was set up on it, which has two disks of 72G bytes and 36G bytes separately. The Network File System has been set up on these two Solaris workstations and a Linux PC.

## Configuration of the NFS server

Setting the NFS server on Solaris includes the configuration of `dfstab` and running of `nfs.server`.

The first step is to edit the file `dfstab`, which resides in directory `/etc/dfs/` and contains the commands for sharing resources across a network. `dfstab` gives a system administrator a uniform method of controlling the automatic sharing of local resources. Each line of the `dfstab` file consists of a share command. The contents of `dfstab` are executed automatically when the system enters run-level 3. In our case, lines like “`share -F ndf -o rw=our-client our-path`” have been added to the `dfstab` file. During the test of NFS settings, executing of these lines as Shell commands are useful so that we did not have to restart the system.

The `nfs.server` file is in directory `/etc/init.d` and is used to start or stop processes required for server NFS.

- Command “`/etc/init.d/nfs.server start`” to start the NFS server.
- Command “`/etc/init.d/nfs.server stop`” to stop the NFS server.

## Configuration of the NFS Clients

To set the NFS client, the `mount` command should be used.

The NFS clients have been set on both Solaris workstation and Linux PC. [5]

Figure 3 shows the architecture of these machines for BEPCII storage ring control so far by now. For the linac control of BEPCII, there is another Solaris workstation which does not use the file server because they it is in different local area network.

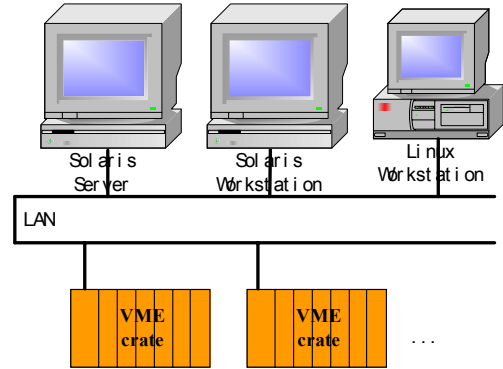


Figure 3: Architecture of the computing environment for BEPCII preliminary design

## Moving the Users' Data to the File Server

There were about 20 user accounts of the control group and the accelerator physics group on the first workstation before the file server was set. Since the users' data must not be destroyed when moving from the first workstation to the file server, lots of cautious works have been done. Firstly the data of one user was moved to the file server and the home directory of that user was set to the file server. After a period of testing, no problem was encountered so the data of most users have been moved to the file server, too.

The file server has been working stably.

## CVS

CVS, the Concurrent Versions System, is an open-source network-transparent version control system which has been successfully applied by many libraries. CVS has been set up and used from the autumn of 2001 on our first Solaris workstation. After the second Solaris workstation with a higher performance has been settled down the CVS root was moved to it and reconfigured in March 2003.

CVS has been used to manage the source codes for EPICS and applications in our system. While upgrading the EPICS base from 3.13.4 to 3.13.8, an unintentional mistake was made and the configuration directory was removed. Fortunately that directory has been checked into the CVS root, so it got recovered.

TkCVS has also been installed.

## SELECTING DEVELOPING TOOLS FOR COMMISSIONING SOFTWARE

Commissioning software of BEPCII will be constructed based on SAD of KEKB.

### *Brief Introduction of SAD*

SAD is a computer program complex for accelerator design. It has been developed in KEK since 1986. The major functions include structural definitions of beam line and component, optics matching, particle tracking, emittance calculation, and so on [6].

SAD has proven to be powerful and useful in designs, simulations, commissioning and improvement of TRISTAN, KEKB, ATF, NLS, JHF and others.

### *Status*

SAD toolkit has been transplanted to IHEP. The development environment for using SAD has been set up. Accelerator physics group has been using SAD to do the lattice design for BEPCII.

The analysis on some key applications of KEKB is in progress.

### **DISCUSSION**

The work of constructing a distributed computing environment for BEPCII control system has not finished yet. The study of network information name service is in progress and NIS+ will be set up soon.

### **ACKNOWLEDGEMENT**

The authors are grateful to the help from the EPICS collaboration which has been offering us very valuable suggestions and encouragement. Thanks also go to KEK people who gave us grate help to use SAD. The authors are also appreciated the support and help from the Accelerator Physics Group in IHEP.

### **REFERENCES**

- [1] BEPCII Design Report, IHEP-AC-Report/2002-01
- [2] J.Q.Wang, Z.Y.Guo, Q.Qin, J.Xing, "Collective Effects Study for BEPCII," EPAC'02.
- [3] Jijiu Zhao, et al, "Control System of BEPCII", ICALEPCS 2001.
- [4] G.Lei, et al, "EPICS Progress at IHEP", Third Asia EPICS Seminar.
- [5] Z. Zhuo, "Realizing of Linux Platform in Distributed Control System by EPICS at BEPCII", this conference.
- [6] <http://acc-physics.kek.jp/SAD>, SAD Home Page.