Status of the Distributed Control System (DCS) for the PEFP 20MeV Proton Linac

Young-Gi Song*, Eun-Mi An, Hyeok-Jung Kwon, Han-Sung Kim, Kyung-Tae Seol, Dae-Il Kim, and Yong-Sub Cho
PEFP, KAERI, 150, Deokjin-dong, Yousung-gu, DaeJeon, 350-353, Korea
*Corresponding author: *ygsong@kaeri.re.kr*

1. Introduction

A 100MeV linear proton accelerator (Linac) is being developed at the Proton Engineering Frontier Project (PEFP) [1]. A 20MeV proton linac has been already developed by assembling 50keV proton injector, 3MeV Radio Frequency Quadrupole (RFQ), and 20MeV Drift Tube Linac (DTL). The PEFP linac is providing users with 20MeV 20mA proton beams as remote control from Central Control Room (CCR). The control system must be capable of operating all of facilities for linac components and controlling machine devices by using a control method based on Distributed Control System (DCS). As a control method for focusing operator's attention on the control points, the DCS architecture based on Experimental Physics and Industrial Control System (EPICS) was adopted [2]. Because the EPICS software architecture model is based on TCP/IP protocol, integrating all distributed subsystems for central operations can be efficiently improved. This paper will discuss the present status of the DCS and CCR for PEFP linac.

2. Description of Distributed Control System

The distributed control architecture for the PEFP linac control is based on multi-layer architecture of distributed Input Output Controller (IOC) systems. Logically the control system will be structured into three layers as shown in Figure 1. Each layer is distinguished by the Operator Interface (OPI) layer, IOC layer and the device controller layer. All the IOC systems are implemented by EPICS application framework which provides a network-based EPICS Channel Access (CA) for the distributed control system. The OPI layer comprises operator console, alarm handler, the CA client programming, sequential control, archive, network management, general computing resources and web monitoring system. The IOC layer consists of several local control stations including host-based Soft-IOC and micro-processor target IOC. The machine device layer is comprised with RF components, cooling system, vacuum units, magnet power supply, beam diagnostic system, ion source, timing system, and interlock system.

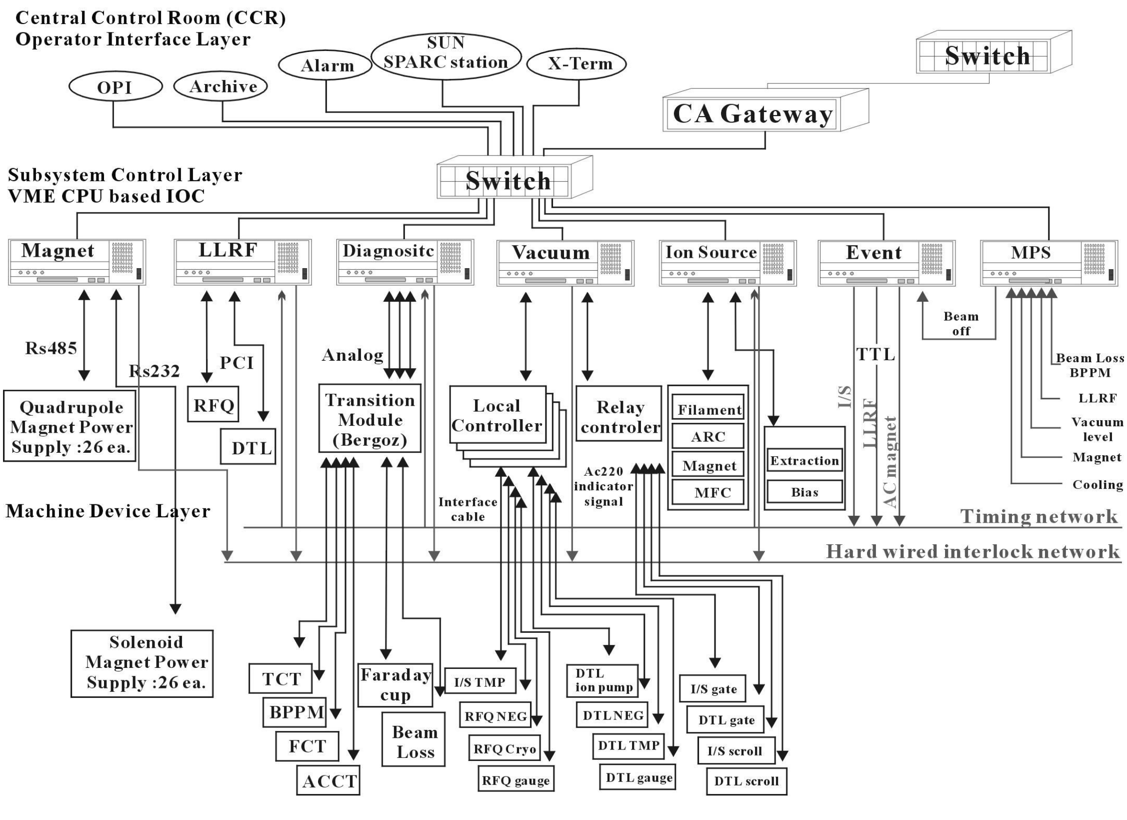

Figure 1. Schematic view of PEFP Distributed Control System

2.1 Hardware

The station of the host-based IOC that runs in the same environment as which it was compiled consists of IBM x3650 server, HP xw6600 workstation, and Industrial Pentium 4 PC. The station of the target IOC that runs in a different environment where compiled is Motorola MVME5100 series PowerPC CPU. There are some signal gateways for the signal acquisition from the linac components by using analog to Ethernet, serial to Ethernet, VME I/O board.

2.2 Software

We have studied how the EPICS system can be used to the specific requirements for the linac machine control. This distributed client/server architectures are depicted in Figure 2. Different levels of access and control reside at distinct layers. At the highest layer 3, access is provided for activities that do not involve moment-by-moment control or monitoring of the accelerator. Layer 3 includes high level physics modeling, making use of live data and data stored in the site relational database. Layer 2 contains accelerator operation and monitoring activities. Layer 1 contains dedicated equipment controllers, which in turn interface to specific equipment through point-to-point protocols in layer 0.

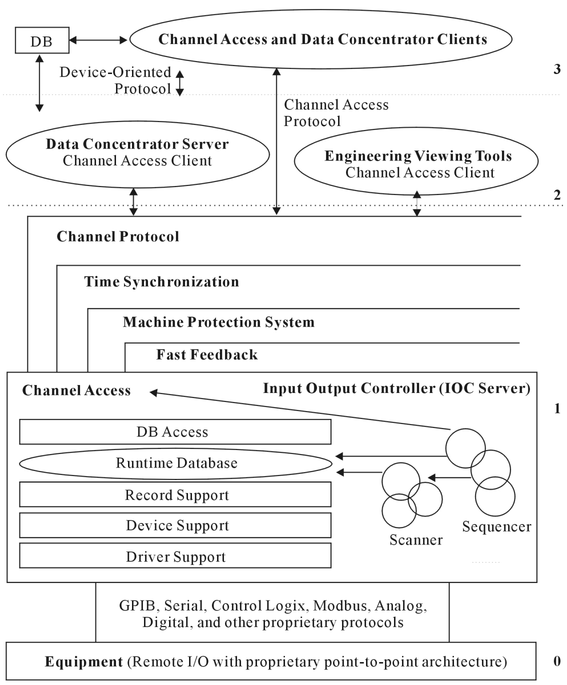

Figure 2. EPICS based IOC software architecture

3. Central Control Room (CCR)

The Central Control Room (CCR) must support several functions about a system operation and entire management. The PEFP CCR has been structured to be capable of controlling and monitoring beam and Radio Frequency (RF) signal, vacuum unit, magnet power supply, cooling, Low-Level RF (LLRF), ion source. The PEFP CCR and OPI is shown in Figure 3. For concentrating communication of DCS, All of the client and server computer are connected to the IOC servers through a Local Area Network (LAN). By using a switch hub for the network, 3Com Fast-Ethernet makes quick and definite access to the distributed controller locations. The EPICS CA is based on TCP/IP protocol. The PEFP DCS adopting EPICS CA protocol makes operators of the CCR focus accelerator operation and control management easily and efficiently.


(a) EPICS CA client OPI (EDM)


(b) PEFP Central Control Room (CCR)

Figure 3. Operator consol for DCS control and CCR

4. Summary and Future Work

The distributed control system is operating without trouble up to now. As the 20MeV PEFP linac was able to be controlled from PEFP CCR, basic DCS was confirmed. According to the remote controller and field signal extension, the DCS and CCR will be upgraded. In the future, a machine protection system (MPS) must be designed under the operation scenario of the PEFP 100MeV. As a basic study, a preliminary interlock control method by integrating a Programmable Logic Controller (PLC) and EPICS IOC will be studied.

5. Acknowledgements

This work is supported by the Ministry of Education, Science and Technology of the Korean Government.

Reference

[1] Byung-Ho Choi, "Status of the Proton Engineering Frontier Project", in the proceedings of PAC05, Knoxville, USA, 2005.
[2]Martin R. Kraimer: "EPICS IOC Application Developer's Guide, "APS/ANL, 1998