

LABVIEW-EPICS INTERFACES IN KSTAR CONTROL SYSTEM

Myungkyu Kim, Myeon Kwon, KBSI, Daejon, Korea

Abstract

The KSTAR (Korea Superconducting Tokamak Advanced Research) officially announced that the EPICS was adopted as a main control software to control and monitor itself. The superconducting TOKAMAK such as KSTAR is required more various kinds of instrumentations compared with the accelerator that EPICS originally introduced. In this paper we describe the EPICS Interface method that deliver the data acquired by using LabVIEW from various kinds of instrumentation to EPICS.

INTRODUCTION

The KSTAR System of Control and Data for EXperiment (CODEX) consists of the Supervisory Control System (SCS), and the Safety and Interlock System (SIS). The SCS is structured as a mixture of the Machine Control System (MCS), Discharge Control System (DCS), Data Management System (DMS), and Diagnostics Control Systems. The SCS also plays a coordinator's role for an integrated control of machines and plasmas without loss of personnel and facility protection. The Machine Control System monitors and controls various subsystems closely related to the tokamak operation such as the magnet power supply control system (MPCS), vacuum monitoring system (VMS), gas control system (GCS), cryogenic control system (CCS), magnet monitoring system (MMS), structure monitoring system (SMS), cooling water monitoring system (UMS), and auxiliary heating system controllers. The Discharge Control System manages and supports the plasma discharge sequences and supervises and coordinates with the Time Synchronization System (TSS) and the Plasma Control System (PCS). The Time

Synchronization System provides reference time and trigger signals to the designated subsystems as well as distributes pre-determined event signal. The Plasma Control System manages all the discharge sequences with necessary feedback control loops. For real time feedback of magnetic and kinetic parameters, PCS will be interconnected with appropriate diagnostic systems and the Time and Event System through the real-time network. The Safety & Interlock System is separated from the Supervisory Control System to perform the protective and preventive safety interlock actions without failures. The Data Management System is the data processing and managing system based on the Model Data System Plus (MDSPlus). Even though MDSPlus can control diagnostics systems, that function will not be used to prevent any interaction between control and management function of MDSPlus.

The KSTAR CODEX System sometimes divided as the Central Control System and the Local Control System. The Central Control System is the control system of which functions are centralized affecting many subsystems. The examples are the Supervisory Control System, the Safety and Interlock System, the Discharge Control System, the Time Synchronization System, the Data Management System, and the Plasma Control System. The Local Control System is depicted as the system managing a sole system of which function is not affecting other systems seriously. The examples are the Vacuum Monitoring System, the Magnet Power Supply Control System, the Cryogenic Plant Control System, the Magnet Monitoring System, the Diagnostics Control System, and the Structure Monitoring System. [1] Figure 1 shows the basic idea of KSTAR control system.

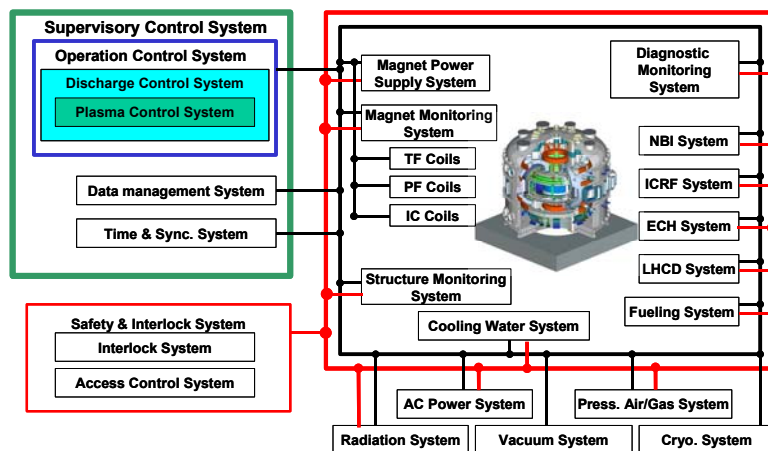


Figure 1 KSTAR Control System

One of the main features of KSTAR control system is the transfer of the control authority by operation phase. It is not until the completion of all preparation of all local I&C system in MCS for generation of plasma that all control authority turn over SCS. After the pulse operation from generation of plasma to finish of discharge, the authority in SCS especially in PCS hands over to MCS again. Originally EPICS is the control system introduced for the system steady state operation oriented, accelerator. Basically EPICS has good features, tool based, distributed, event driven, and high performance. The TOKAMAK adopt superconducting magnet for plasma confinement is possible in long pulse operation, which require EPICS to connect, share information, and control for a number of instrumentation in a time. In the meantime flexible change toward EPICS that support various kinds of platform or communication such as PXI, RS232, GPIB, PLC, USB, field-point, OPC, etc are also required. The former means more easy and simple method in realization of EPICS, the R&D for this target has been done in several research groups.

- Realization of Channel Access using ActiveX [3][4],
- Improvement and realization of CA using Simple Channel Access [5],
- Data exchange with IOC-Core using shared memory [2],
- Support IOC-Core on Windows OS since EPICS 3.14. x [6]

In this paper we describe the method about how to import the local I&C system to EPICS and how to use it.

LABVIEW-EPICS INTERFACES

LabVIEW-EPICS Interfaces are developed to make EPICS Input/Output Controller (IOC) on Personal Computer (PC) itself. LabVIEW-EPICS Interfaces are the utility software system to provide the EPICS interface for Non-VxWorks system and to support data monitoring and control of Non-VxWorks Local I&C system and also to provide easy user interface and develop environment for EPICS users. Embodied existent EPICS has advantage that have sufficient real-time function, and offer very stable system by being embedded to controller's CPU through VxWorks, but cost is rather high, and also the hardware that it sufficiently support these function has fairly limited in variety. On the other hand, already mentioned PC based EPICS IOC is being considered in cost and in performance.

LabVIEW-SCA DLL-IOC Core

Simple Channel Access is a simplified version of EPICS CA, a communication protocol through network, first developed by ALS[5]. SCA combines both convenience and power, providing a rich, efficient set of channel access functions while removing many of the more complicated challenges of programming the CA protocol. SCA requires the programmer to worry only about the channel structure itself, and not how it is

implemented at the hardware level. Two types of methods are available, directly using of dynamic link library (DLL) and ActiveX. In these methods, the data is firstly acquired by LabVIEW program, after that is delivered to IOC-Core using SCA DLL or ActiveX SCA, then finally the EPICS Sever function are implemented. In figure 2 the simplified connection of LabVIEW-SCA DLL-IOC Core are displayed.

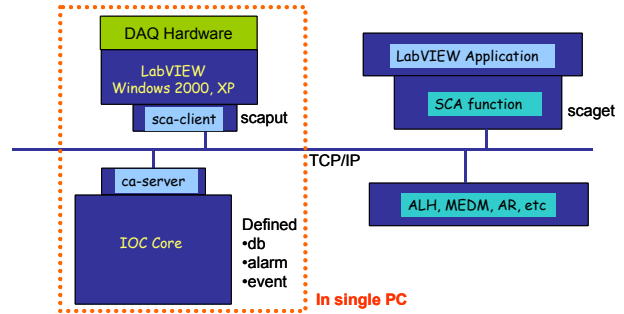


Figure 2 The Connection of LabVIEW-SCA DLL-IOC-Core

LabVIEW-Shared memory DLL-IOC Core

Using shared memory LabVIEW can share the data with IOC Core. The main portions are developed in SNS(Spallation Neutron Source) project. Figure 3 shows the simplified concept of shared memory-IOC Cores.

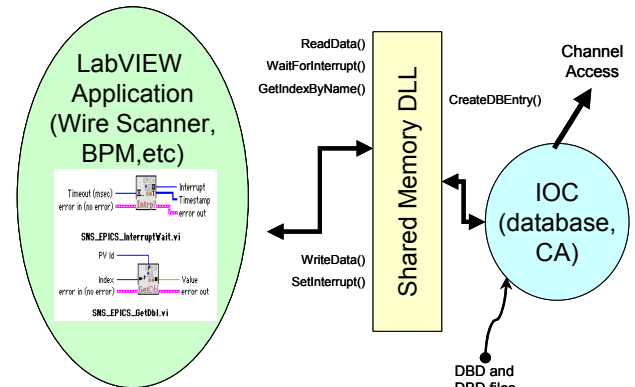


Figure 3 Concept of Shared Memory-IOC Core[2]

LabVIEW ActiveX CA Server/Client

ActiveX is the name Microsoft has given to a set of strategic object-oriented programming technologies and tools. The EPICS CA using ActiveX is to realize EPICS IOC in Windows environment, used instead of the technology that embody IOC core directly in PC. The LabVIEW Program that can handle ActiveX Control function to achieve IOC-core's function directly. However, this method has a weak point that cannot carry out the database related work that is one of main function of EPICS. Figure 3 shows the concept of ActiveX CA Server / Client.

Adaptation

In local I&C system, the templates are under developing to make EPICS IOC simply. Through series

works of IOC Core Program installation, EPICS Database File creation, and IOC Core execution etc., LabVIEW application program offers simple user interface and develop environment. Figure 4, 5 are the developed utility programs for User Interface Display.

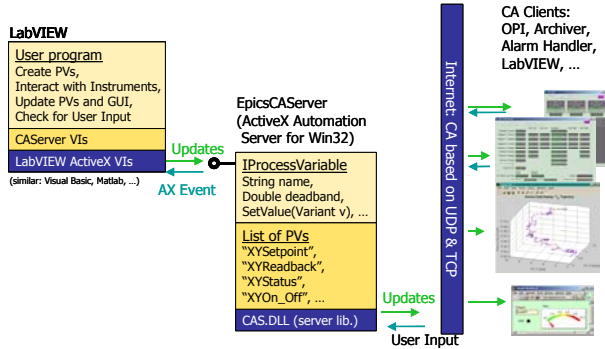


Figure 4 Concept of ActiveX CA Server/Client[3][4]

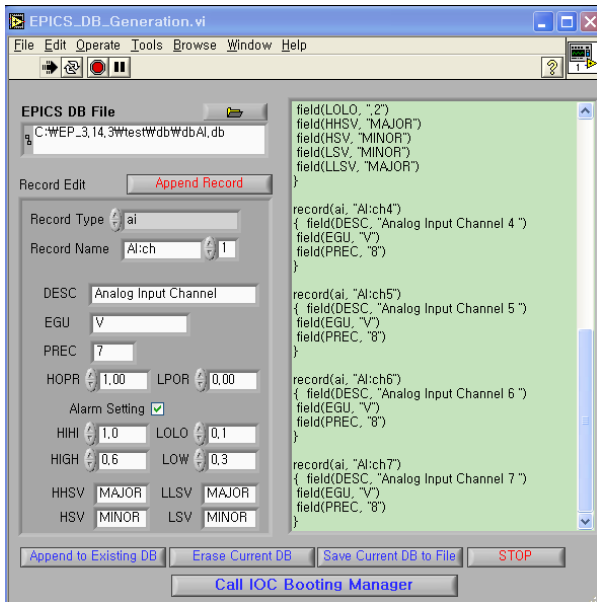


Figure 5 Utility LabVIEW application for DB

CONCLUSION AND FUTURE WORKS

This paper presented the implementation of LabVIEW-EPICS Interfaces at KSTAR. The system is based on Windows 2000 or XP, LabVIEW, and IOC-Core. A software has been developed to interface LabVIEW to EPICS IOC-Core with simple and easy user interface and common program structure. It is important that select a method having stability, speed, and convenience.

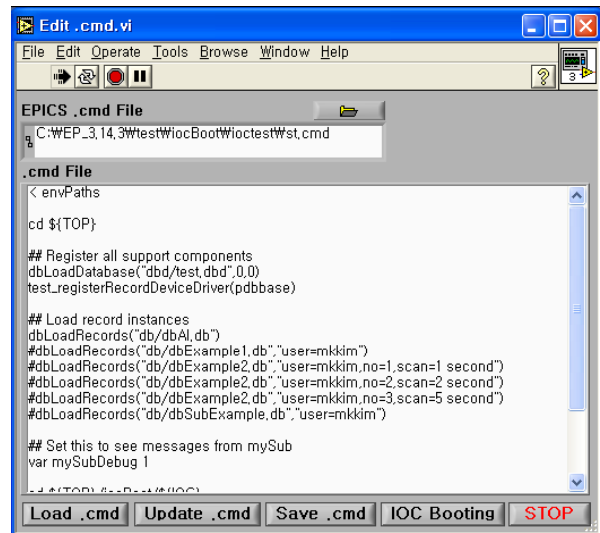


Figure 6 Utility LabVIEW application for IOC Core

The biggest problem of Windows OS is first, is not stable comparatively, and second, it is that stability is fallen greatly by virus. If the system is linked by EPICS, a individual machine infected by virus, this can cause serious problem being transmitted immediately by whole system. There is a method to use Linux by method to escape these problems. Also, to protect system from virus, the separation of network for control system can be a countermeasure. Already LabVIEW and EPICS IOC are available in Linux, sooner or later ActiveX is also possible in Linux. The programming templates are being developed to include any system or method, testing and debugging in real system is also required.

REFERENCES

- [1] "KSTAR Control System Design Description Document", published in October 2003.
- [2] D. Thompson, W. Blokland, E. Williams, "Running IOC Core on Windows and Linux" EPICS Collaboration Meeting, June, 2003
- [3] K. Kasemir, "Making LabVIEW look like an IOC", May, 2002.
- [4] K. Kasemir, et al, "Integating LabVIEW into a distributed computing environment", ICALEPCS 2001.
- [5] C. Timossi, et al, "Experience with ActiveX control for Simple Channel Access", PCAPAC 2002.
- [6] J. Hill, et al, "EPICS:Input/Output Controller Application Developer's Guide", Release 3.14.4