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Improvement of Control Infrastructure and High Level Application for KOMAC LINAC

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1. INTRODUCTION

The Korea multi-purpose accelerator complex (KOMAC) has two beam extraction points at 20 and 100 MeV for proton beam utilization [1]. There are about 70 control systems for controlling the KOMAC subsystems, such as the ion source, the radio frequency, the diagnostic devices, the magnet power supply, and the cooling system. The infrastructure which includes network system, local controllers, and control system environment was required to be changed to process increasing process variables without fail. Experimental Physics and Industrial Control System (EPICS) based high level control environment which includes alarm, data archiving was changed to support the improved infrastructure of KOMAC control system [2]. In this paper, we will describe the improvement of infrastructures for the KOMAC control system and EPICS based high level application.

2. CONTROL SYSTEM INFRASTRUCTURE

The KOMAC linac which started the beam service in 2013 consists of sub-components, such as vacuum units, magnet power supply, beam diagnostic system, low-level radio frequency system, and resonant control cooling system, etc. For a stable and efficient linac control system during the initial design of KOMAC control system, the control requirement was integrated remote control, distributed control, and efficient maintenance, etc. A set of EPICS open source software tool to implement distributed soft real-time control system for stable beam acceleration was adapted. The distribution control method chosen to control the linac was based on multi-layer architecture with IOC (Input Output Controller) systems. Logically the control system was structured into three layers as shown in Fig 1.

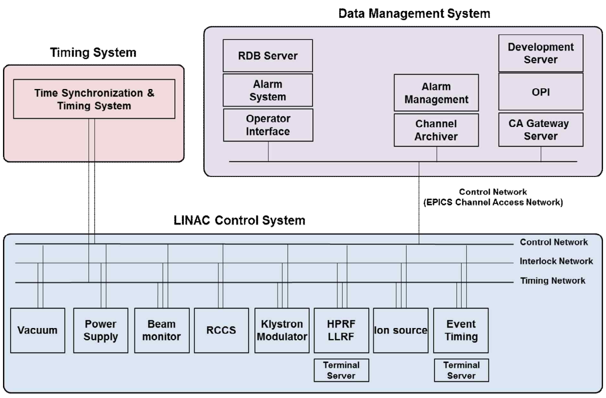

Fig. 1. Overview of KOMAC control system

The control network is based on Ethernet. It delivers Channel Access (CA) protocols which are standard protocols in the KOMAC control system to transfer control data. The Operator Interfaces (OPIs) and control data archiver also use the CA protocol. For more stable network, the network redundancy has been applied to the control network.

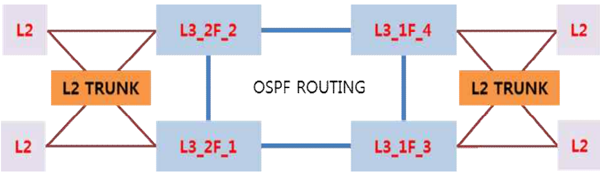

Fig. 2. Control Network Redundancy (OSPF, Open Shortest Path First)

There are a variety of high level applications. EPICS IOC must serve requests from the various high level applications including EPICS extensions. A CA gateway has been installed because we need to reduce server resources and network traffic by using CA gateway as shown in Fig 3.

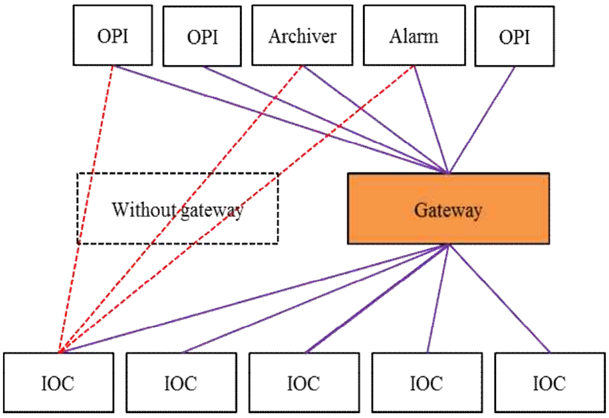

Fig. 3. Channel Access Gateway allows access control and filtering

The CA gateway was involved in the control network. The CA gateway is working as a proxy server, so it reduces the number of CA connections for individual IOCs. The CA gateway also provides an access control feature. The CA gateway also provides the virtual connection among CA servers and clients. Usually, many of the CA connections would be established among IOCs and OPIs. The CA gateway makes virtual circuits internally to reduce the number of CA connections on the server (IOC) side. This is a very useful trick to save CPU power so that it will be used for higher priority tasks instead of the communication task in a real-time system.

3. EPICS BASED HIGH LEVEL APPLICATION

The EPICS software tool provides the channel access communication protocol to make TCP/IP connections and transfer process variables among EPICS based IOCs. There are many tools that are used to make operator interface and to make a data archiving system. We improved EPICS based high level application such as alarm and data archiver system.

3.1 Alarm System

In order to improve the existing system and more user friendly alarm system, we adapted the Best Ever Alarm System Toolkit (BEAST) as well as Alarm Handler (ALH) [3]. It is based on Java and Eclipse on the Control System Studio (CSS) platform, using a Relational Database (RDB) to store the configuration and to log actions. It employs the Java Message Service (JMS) for communication between the modular pieces of the toolkit, which include Alarm Server to maintain the current alarm state, an arbitrary number of Alarm Client user interface (GUI), tools to annunciate alarms or log alarm related actions. Figure 4 shows BEAST user interface for alarm system.

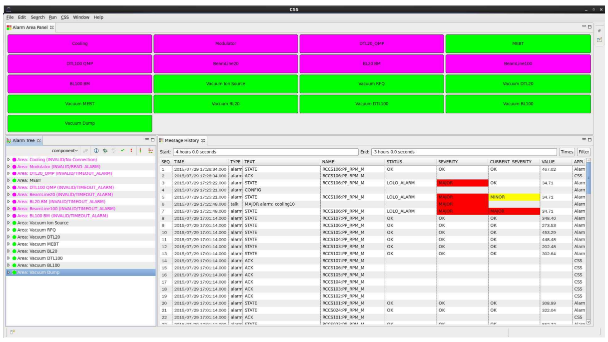

Fig. 4. Alarm User Interface using BEAST

3.2 Data Archiver System

Channel archiver engines are operating under Linux machine. Total Process Variables (PVs) are about 10,000 and about 700 PVs in which 780 MB is achieved in a day at the file base and RDB (MySQL). Figure 5 shows PV numbers being used by the KOMAC control system.

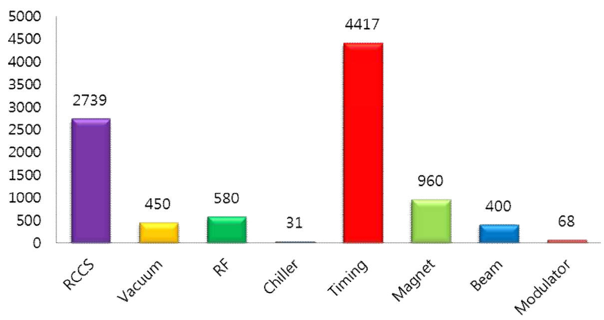

Fig. 5. A numbers of counts of process variables

RDB system of archiver data server is redundant with the MCCS software toolkit. The archiver database in MySQL is dumped to Network Attached Storage (NAS) system once a week. Figure 6 shows a redundant system for data archiver system and network storage system using NAS.

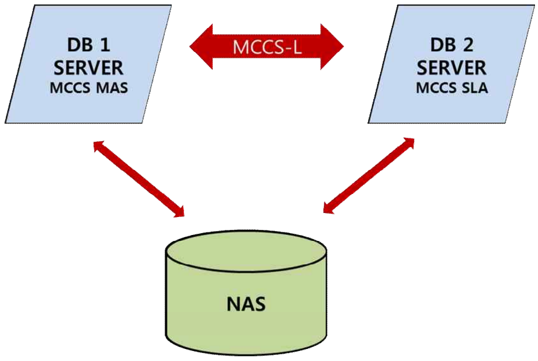

Fig. 6. Schematic diagram of database redundant system using MCCS software toolkit

4. CONCLUSION

We improved the control network environment and EPCIS based high level application for enhancement of the KOMAC control system. In the future, operator interfaces will be improved to a centralized interface and a web interface system.

5. ACKNOWLEDGEMENTS

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