

FACILITY MONITORING SYSTEM USING STORAGE AREA NETWORK FOR VEC AND SCC

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Abstract

The facility monitoring system of cyclotron operational parameters at VECC is developed and commissioned recently. Storage Area Network (SAN) is used to isolate the control LAN and office LAN which ensures secured access of the control systems from outside world. EPICS gateway service and modified channel access save/restore tool have been used to integrate EPICS based control system of VEC and SCC with office network. This paper describes the implementation details of the overall facility monitoring system.

INTRODUCTION

The control systems of K130 variable energy cyclotron (VEC) and K500 superconducting cyclotron (SCC) at VECC, Kolkata, are isolated from each other as they run separately in their respective control network. However, online and historical monitoring of many important control parameters of both the facilities are required to be viewed from both the control rooms for proper diagnosis, maintenance and operation. Moreover, the facility managers, sitting at office network, require the automatic update of statistical information e.g. number of hours of beam time supplied to user, planned /unplanned shutdown etc. and hence, availability of control parameters from office network for automatic generation of operating reports and statistic in an application like spread-sheet for both the facilities are required. A facility monitoring system has been developed to cater all these requirements while maintaining access security aspects of the control networks as described in the subsequent sections.

PHILOSOPHY

A storage area network (SAN) is a dedicated network which is primarily used to make storage devices, accessible to computer servers. These storage devices appear like locally attached drive to the operating system of the server. A SAN network of storage devices is not accessible through the local area network by other devices and hence transaction of data from one network to other by means of SAN storage reduces vulnerability of cyber security threats. The facility monitoring system at VECC has been developed by adopting this idea where all the important parameters of both the facilities are transferred to the Office network for facility managers. A EPICS Process variable (PV) Gateway server [1], which can be

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configured to collect PVs from isolated networks and transmit them to another network, is installed. A software-based Firewall is also installed in the same Gateway server to provide the required access to perform CA monitor process to collect PVs from the IOCs running in the control networks. As all the required parameters can be accessed from the gateway server, one SAN server (SAN-1) is connected with the gateway server in a separate network. A channel access save/restore tool [2] is modified and installed in SAN-1 to save all parameters, to be forwarded in office-network, in the common storage. The other SAN server (SAN-2) which is connected in office network can access data-file containing the control parameters from the common storage. With this philosophy, one would ensure security of the control networks while passing all the required parameters in a separate network.

ARCHITECTURE

The overall system is divided into two layers where the first layer is the PV gateway layer (Dell PowerEdge) and second one is a storage area network where two servers (HP Server-1 and HP Server-2) are connected with a common storage through a point-to-point fibre channel as shown in figure 1. The gateway service is responsible for collecting all required parameters from SCC and VEC networks using EPICS channel access protocol. A channel access server process is available inside the gateway service which transmits all control parameters collected from the SCC and VEC control networks towards the SAN system. The gateway process has the ability to apply access security in addition to the access security configured in the firewall, running in the same gateway server, and hence, all incoming PVs are configured with read only access in the PV gateway.

The process running on SAN-1 server collects the monitoring parameters from the gateway server using CA protocol and saves the data into the common storage. The office-side server i.e. SAN-2 contains an duplicate EPICS IOC with all the PVs similar to the PVs collected from VEC and SCC control networks for monitoring. A modified channel access restore process on office-side retrieves the data from the common storage and update the duplicate IOC. An Apache-based web server running in SAN-2 collects the data from the IOC using EPICS CA-plugin application. The user can view the parameters in a web browser from the office LAN as shown in figure 2 and figure 3. The common storage (2.1 TB) is configured with RAID 5 and is divided into three logical

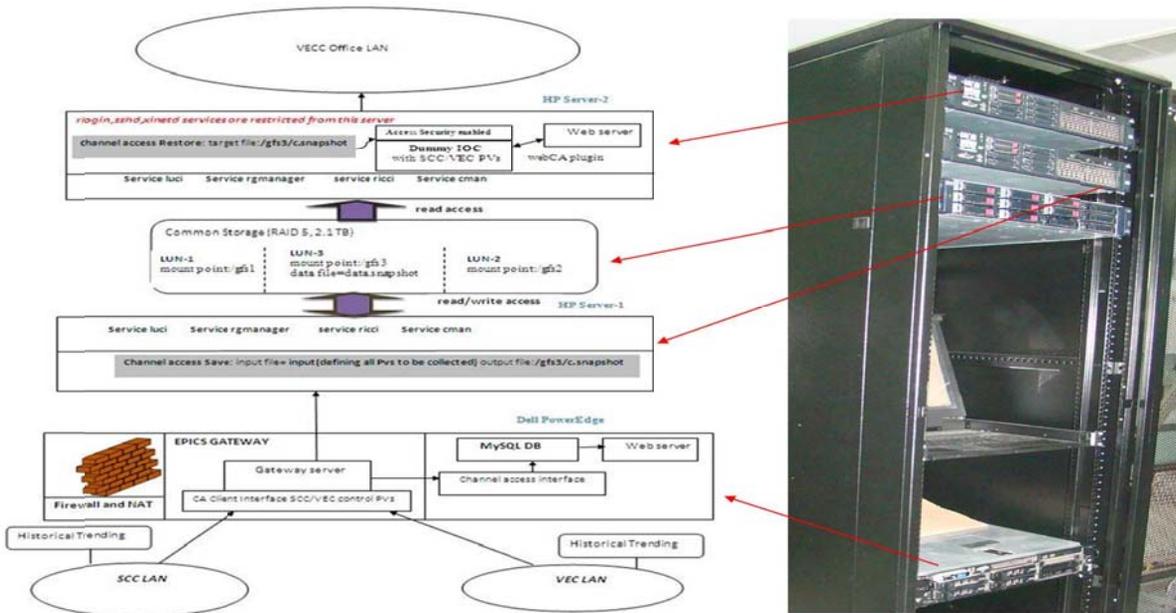


Figure 1: Architecture of SAN-based Facility Monitoring System.

units. One logical unit is currently used for storage of online data and two units are kept for future use of historical data trending from office LAN. The file locking and sharing functions are handled by Red Hat Global File System (GFS) for each server in the SAN system. The inside server of the SAN storage system has read/write access to the common storage whereas the outside one has been configured with read access only as shown in figure 1. In addition to this, the access security in the duplicate IOC is configured in such a way that it will only allow SAN-2 to update its database. These features prevent the write access of control data from office LAN to ensure additional data security.

VEC Live Status

25-4-2012, 02:58pm

Current Status Trim coil Power Supply Beam line Power Supply Deflector Power Supply Vacuum

Main Machine Parameters

Main Magnet(Ampere)	842.5
Dee Voltage(kVolt)	0
Filament Current(Ampere)	381
Arc Voltage(Volt)	379
Arc Current(Ampere)	0.5
Gas Flow(secm/s)	7.41
Gas Type	Helium

Figure 2: On-line control parameters of VEC in web browser.

SCC Live Status

25-4-2012, 03:00pm

SCC Current Status Beam line Vacuum RF Power and Phase RF Forward/Reflected Power Cryogenic Load

Main Machine Vacuum

Main Machine-BC2(mbar)	5.99	E-07
Main Machine-BC3(mbar)	5.49	E-07
Main Machine-BC4(mbar)	7.61	E-06
Main Machine-BC5(mbar)	NaN	E-00
Main Machine-OVC(mbar)	4.44	E-07
Main Machine-Lower Liner(mbar)	6.99	E-02
Main Machine-Upper Liner(mbar)	7.54	E-02

Figure 3: On-line control parameters of SCC in web browser.

SCOPE OF EXTENSION

So far, the facility monitoring system from the office network has been described, however, EPICS and MySQL interface, developed in-house [3] can also be installed and integrated to monitor the control parameters of VEC from SCC control room and vice-versa. The web-tool support available for historical trending and online monitoring of archived data as shown in figure 4 and figure 5 in the EPICS-MySQL tool-set will enable to achieve this facility very easily. The control parameters can be collected from the Gateway server and Firewall will be configured in such a way that it will allow access of MySQL database from both the control room.

EPICS MySql Archiver
Started on: 12:34:22.633, 2011-01-09

Historic plot

System: Vacumm
Sub-system: Main_machine

Name/Value	Time stamp	Date stamp	State	Log type	Description
VAC_MM_BC2 6.608e-07	13:36:09.236	2011-02-17	OK	scan	
VAC_MM_BC3 6.906e-07	13:36:09.236	2011-02-17	OK	scan	
VAC_MM_BC4 9.462e-06	13:36:09.236	2011-02-17	OK	scan	
VAC_MM_BC5 0.000e+00	13:36:09.236	2011-02-17	OK	scan	
VAC_MM_OVC 8.689e-06	13:36:09.236	2011-02-17	OK	scan	
VAC_LOLNER 8.179e-02	13:36:09.236	2011-02-17	OK	scan	
VAC_UPLNER 8.906e-02	13:36:09.236	2011-02-17	OK	scan	

Figure 4: EPICS-MySQL Archiver.

REFERENCES

- [1] The Process Variable Gateway, <http://www.aps.anl.gov/epics/extensions/gateway/index.php>
- [2] The EPICS Channel Access Save - Restore Tool, <http://www.aps.anl.gov/epics/meetings/2002-111/talks/maclean1.pdf>
- [3] A. Roy et al., "EPICS MySQLArchiver – Integration Between EPICS and MySQL", THCB02, these proceedings.



Figure 5: Historical trending in EPICS-MySQL interface.

CONCLUSION

The MySQL database can also be installed in the SAN-2 server which will collect all control parameters from duplicate IOC. It will provide historical trending facility from office network for facility managers as well for respective system personnel. The in-house CCTV system can also be integrated with this system for campus-wide monitoring facility of on-line cyclotron parameters.

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