OPERATIONAL EXPERIENCE WITH SCADA SYSTEM BASED CONTROLS FOR INDUS-2

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Abstract

Indus-2 is 2.5 GeV synchrotron radiation source. The control system for Indus-2 was put into operation in 2005. The control system has been built using Supervisory Control and Data Acquisition (SCADA) tool PVSS-II for all the supervisory-level accelerator operation applications. The paper describes the work that has been accomplished using PVSS-II 3.0 in all the areas like API manager development for communicating with external applications, operator interface development with various system and field diagnostics information made available, prioritized alarm configuration and management and database archival to a central external database server. The paper further outlines the experience gained with PVSS-II in utilizing its features for continuous up gradation and testing aspects. The flexibility achieved and its importance in the commissioning and operation of the synchrotron utilization source is discussed. The paper also briefly comments on the PVSS system performance.

INDUS-2 CONTROL SYSTEM

The control system is based on master slave architecture having three layers as **User-Interface layer (UI or L1)** which consists of desktop PCs , **Supervisory Control layer (SC or L2)** which consists of VME bus based CPUs running OS-9 and **Equipment Controller (EC or L3**) which consists of VME bus based CPUs and various DAC, ADC and Digital I/O cards. Ethernet between UI & SC layers and Profibus between SC and EC layers are used for communication.

The various sub-systems of Indus-2 control system are Magnet Power Supply system, RF system, Beam Diagnostics system, Timing system, Radiation safety and surveillance system, Beamline Frontend system, Interlock system and Vacuum System.

PVSS FOR INDUS-2 CONTROL SYSTEM

The core component at L1 is PVSS-II, a modular, distributed and device oriented system having the basic functionalities required by the control system [3].

Data Point (DP) Structure

PVSS defines structured data points which are used to monitor and control devices. Creation, modification and additions to the DP structure is done easily with PVSS. A magnet power supply DP is seen in Figure 1. The master DP allows easy configuration of alarms and range settings. Nearly 20000 DP elements catering nearly to 10000 field i/o points are used for Indus-2.

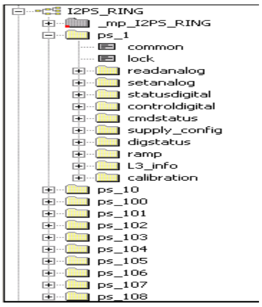

Figure 1: DP Structure of a Magnet Power Supply.

Application Programming Interface (API)

The extensive library support in form of API provided by PVSS proved very helpful in interfacing to the SC layer of the Indus-2 control system [1].

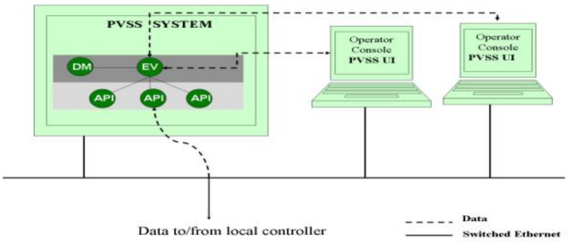

Figure 2: PVSS System Architecture at L1.

The API managers poll L2 periodically over Ethernet to get device data. User commands and settings are given in the User Interface Manager (UIM), which in turn are transferred from API manager to L2 as seen in Figure 2.

Control Script

Background processes can be run using control script. This proves very advantageous when sending configuration information at the start-up of any L3 station or logging of events/actions performed or some processing on DPs etc.

GUI

The event-triggered functions can be written coupled in GUI script. PVSS has many widgets with drag and drop facility for rapid development. Usage of reference panels maximizes reuse of code.

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Data Logging

Periodic logging of machine parameters is done using the PVSS DB interface for accessing external databases. Nearly 8000 parameters are logged.

Alarms

PVSS allows us to configure our own alarm model with a very flexible alarm definition scheme [4]. The alarm handling system handles nearly 1000 alarms of entire sub-systems of INDUS-2.

Interface to External Applications

PVSS interfaces with various Labview, Matlab and Java applications over TCP/IP or using the serial interface. ActiveX controls can also be embedded.

EXPERIENCE WITH PVSS

The Indus-2 control system was commissioned in 2005. This included other than the installation of three-layer networked infrastructure for all the sub-systems, the installation of PVSS client nodes, servers and Database servers. According to study done by CERN for evaluating various SCADA tools suitable for high energy physics experiments, PVSS was found to be most suitable [2].

Testing

The client server aspect of PVSS helped in testing the systems without interfering with the running system. Any well-tested system on local host could be easily integrated with existing PVSS system on server by simply importing the DP structure and list through ASCII files. Separate APIs enable part testing of system.

Scaling Up

From commissioning to full operation of INDUS-2 various sub-systems were gradually added to the control system. Since PVSS is highly flexible and scalable so development, testing and integration of new systems proved to be a hassle free job [4]. It required instantiation of the required number of devices and API development for the new sub-system. With time, control managers and API managers have been added. The corresponding data logging modules and alarms were integrated to the system. The systems could be easily added to the 100 Mbps switched network average network load being ~1 Mbps. The number of remote clients on the network is ~12 which is nearly the same since the start of machine. Tests have been performed in CERN to affirm the scalability of PVSS system of larger magnitude [5]. For Indus-2 control system, using PVSS has resulted in similar experience.

Diagnostics

PVSS provides diagnostic information about its resources like hard disk or RAM utilization, manager states, clients connected etc. This information has been used extensively and made available to the operator so that problems occurring in any sub-system can be rapidly diagnosed and rectified.

PERFORMANCE OF PVSS

The overall performance of PVSS for Indus-2 controls has been very satisfactory. The PVSS server is a 2.8Ghz Intel Xeon dual processor, catering to eight sub-systems of INDUS-2 and has interface to various other external applications. The performance aspect comprise of one second polling by each sub-system API over TCP/IP, running data logging modules on 24X7 basis, running other background processes, handling alarms and their logging etc. Presently one server is able to handle all the DPEs (~ 20000) without difficulty. With all systems working, the CPU load on average is 18% with peak memory usage of 40 MB.

In the PVSS-II, despite its good graphic editor some features like trend label and header setting, multiple selections in lists, printing from trends etc. are lacking and need to be enhanced. ActiveX integration and coding is not very easy. Bad scripting (e.g. using infinite while loops, DP functions which are not optimized etc.) resulted in heavy CPU load or generated large network traffic if the script was running on client machine. Too many alarms at any instance result in unknown state of the DP. A few improvements need to be done in alarm handling like multiple audios on multiple types of alarms, generating audio only when desired, time hysterisis etc. Archived data is not accessible outside PVSS. Difficulty was faced in integrating Windows API calls in the PVSS API.

CONCLUSION

The usage of a PVSS-II SCADA system has resulted in a well-organized and managed control system. Its main characteristics being that it integrates the various sub-systems located in the field area into one supervised control. Indus-2 is operational on 24*7 basis since February 2010 with beam current 100 mA at 2.0 GeV. During this period PVSS system has been running without any failure.

REFERENCES

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