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DIAGNOSTIC TOOL FOR COMPACTPCI CRATES

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Abstract

On the control system hardware platform for the Taiwan Photon Source (TPS) more than half use CompactPCI crates. If a crate malfunctions, the internal crate card will not operate properly affecting accelerator operation. If the crate, however, could provide instant remote operational information, an opportunity exists to maintain or replace it in advance. Therefore, a diagnostic tool was developed to analyse and diagnose the condition of the crates. When abnormal operations occur, an alarm can be issued for early inspection and maintenance. This way it is possible to prevent the EPICS IOC from crashing by CompactPCI crates, which improves the reliability of accelerator operation. A detailed system architecture, implementation and progress will be discussed in this report.

INTRODUCTION

The Taiwan Photon Source (TPS) [1] is a 3 GeV synchrotron light source which was constructed at the National Synchrotron Radiation Research Center (NSRRC). The TPS control system [2] is based on the Experimental Physics and Industrial Control System (EPICS) [3] framework. The EPICS toolkits provide standard tools for display creation, alarm handling, archiving data and more. The devices are connected to an Input Output Controller (IOC) based on EPICS via a control network connection. Many devices in the TPS control system hardware are compatible with SNMP, such as: CompactPCI (cPCI) crates, Uninterruptible Power Supplies (UPSs), network switches etc. Figure 1 shows the device which supports an SNMP in the TPS control system. The number of devices is very large and it is difficult to monitor all these devices. Establishing a tool to automatically diagnose the device condition is desirable. We chose to monitor the cPCI crates first and create tools to diagnose their condition.

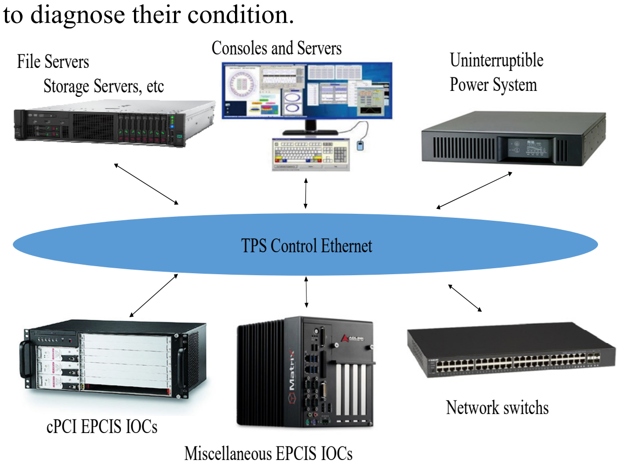

Figure 1: SNMP support for devices in the TPS control system.

The CompactPCI (cPCI) is equipped with input/output modules as a standard EPICS IOC to control subsystems. In the TPS control system more than half using cPCI as hardware control platform. The cPCI are installed inside the Control Instrumentation Areas (CIA) which are distributed along the outside wall of the machine tunnel.

To achieve a high availability of the TPS control system the cPCI crates must be reliable. We therefore create a cPCI crate diagnostic tool to collect status and diagnostic information to maintain the reliability of the TPS control system. The EPCIS IOC can read the status of the cPCI crates and use the diagnostic tool to monitor their condition. When abnormal conditions occur, such as a crate overheating, a power breakdown, a fan working abnormal or failing, the diagnostic tool will show an alarm message on OPI (Operator Interface) and send alarm notification to the responsible personnel via E-mail.

EPICS SNMP DEVICE SUPPORT

SNMP

The SNMP (Simple Network Management Protocol) is a standard Internet protocol for managing and organizing information of Ethernet-based devices. SNMPs have been developed in three significant versions: v1, v2c, v3. Depending on the different version they have different features such as performance, flexibility and security. The SNMP is composed of a managed device, an agent and a Network Management System (NMS). A managed device is a network node that implements a SNMP interface to collect and store management information and make this information available to NMS using SNMP. An agent is a software module that resides on a managed device and allows it to collect management information from the managed device database and makes it available to the NMS. An NMS executes applications that monitor and control managed devices and regularly polls data from agents.

DevSNMP

The devSNMP [4] provides EPICS device support for hardware devices that communicate via SNMP, and can use access management data from any network device in the same manner. By using devSNMP, the EPICS IOC can query data from devices via SNMP, then store data in the EPICS database for PV channel access. The OPI shows the device information via the Channel Access (CA) protocol.

In Fig. 2 we show the system structure of an EPICS integrating an SNMP with a cPCI crate in the TPS. The EPICS IOC retrieves information via SNMP from the cPCI crates and the information will be stored in the EPICS database for PV channel access. The OPI can show crate information via channel access and the diagnostic tool can use the data to diagnose the condition of the crates.

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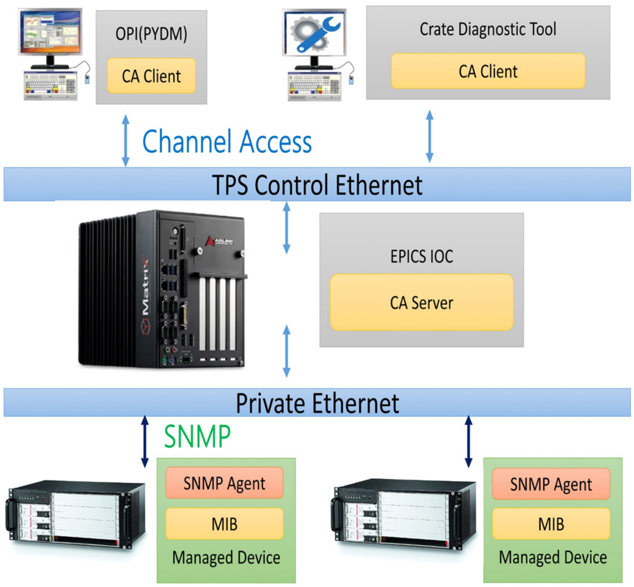

Figure 2: System structure of EPICS integrating an SNMP with a cPCI crate.

CRATE DIAGNOSTIC TOOL

In the TPS control system, the more than 30 cPCI crates are distributed in different CIAs. We cannot monitor the crate status all the time. Therefore, the diagnostic tool is used to monitor automatically the crate status all the time and create an OPI to display device information [5]. In addition to the monitoring screen, the diagnostic tool will constantly confirm the crate status and if an abnormal condition occurs, an alarm will be issued. The alarm information shows the location, time and status of the failed device to speed up troubleshooting.

Each cPCI crate has an alarm board with SNMP support which can use an SNMP command to monitor the cPCI crate status. The alarm board provides the parameters of the crate status including fan speed, crate temperature, voltage, power supply status, etc.

The EPICS IOC will poll the data from the cPCI crates and use them on the PyDM display page and diagnostic tool.

Crate Diagnostic Program

The crate diagnostic program is built by using python and the python epics (PyEpics) [6] package provides several functions to interact with EPICS channel access. Therefore, it can get data from a PV or can put a value to the PV. This tool constantly confirms the status of the crates. If the component status is in error or the value is not between upper and lower limits, this tool will put the value on a soft channel, let the OPI show a red light on the PyDM crate component or crate status and send an alarm via E-mail. The abnormal message will be stored and can be shown on the PyDM as a historical message. The crate diagnostic program flow chart is shown in Fig. 3.

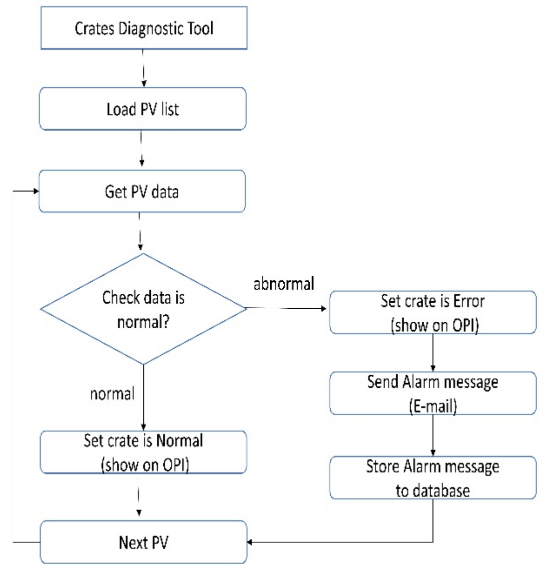

Figure 3: Crate diagnostic program flow chart.

PyDM for Monitor cPCI Crate

The Python Display Manager (PyDM) [7] is based on the PyQt [8] framework to build a user interface for control systems. The PyDM supports EPCIS channel access which can let the PyDM control and monitor EPICS PVs. The PyDM is built by Python and Qt. It provides a system for the creation of user interfaces using Qt Designer, and allows for the creation of displays driven by a Python code. Developers can extend the framework with custom widgets for specific tasks.

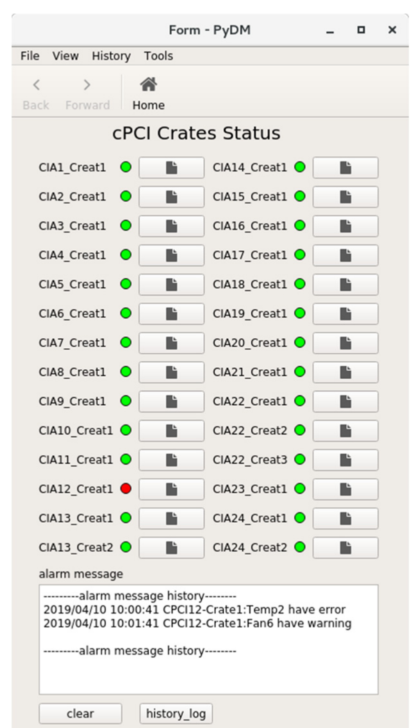

Figure 4: PyDM page for the status of all cPCI crates.

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Figure 4 shows the status of currently connected crates. The green circles indicate proper functioning of the corresponding crate. If there is a problem, a red circle is displayed. At the bottom of the page, an abnormal message can be displayed, which indicates the position of the crate, the time and cause of the abnormal state. Clicking the button (history log) displays the history of the abnormal message.

The button next to the circle showing the crate status can open another page that shows a more detailed status of the cPCI create. Figure 5 shows the status and values of each component. This page shows the crate temperature, fan speed, operating voltage, power supply status, and digital output pin status. If the component is not running, a red circle is displayed and if it is normal, a green circle is displayed. If the value is not between the upper and lower limits, a yellow frame warning will appear. On the right side of the page, one can see the waveform of the crate fan speed and crate temperature. If any abnormal state occurs, the top light will be displayed in red, and the corresponding light on the main page will also be changed to red.

Figure 5: PyDM page with information for cPCI crates.

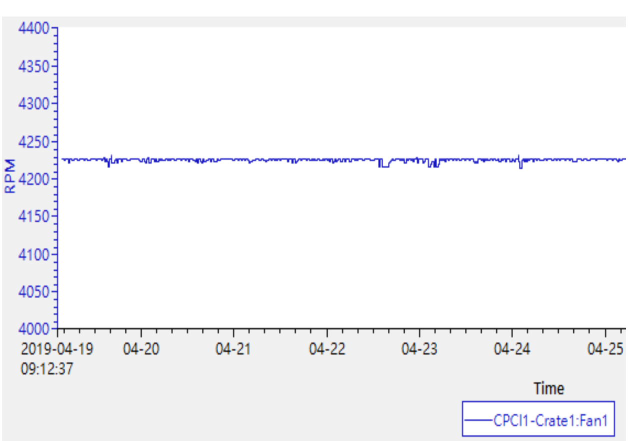

Figure 6: CS-Studio Archive data browsing page for fan speed of a crate.

EPCIS Archiver Appliance

Figure 6 shows the CS-Studio Archive data browsing page. The CS-Studio based archive system can store data in a relational database (RDB) [9]. It can store crate component values such as fan speed and temperature from EPICS IOC to provide historical data for analysis of the crate condition.

SUMMARY

Maintaining high reliability of the TPS control system is important for the operation of the accelerator. The hardware platforms in the TPS control system are distributed in different CIAs. It is important to maintain these devices to operate. Therefore, it is necessary to have an infrastructure monitoring system to monitor these devices. These devices, such as cPCI crates, network switches, UPS, etc., are supported by SNMPs. Since the TPS control system is based on the EPICS framework, we use SNMP EPICS device support for development. First, we developed the cPCI crate diagnostic tool to automatically and continuously poll each crate state.

If cPCI crate have an abnormal state occurs, the tool will send an alarm notification is sent to the responsible personnel by E-mail and it can be displayed on the OPI. The OPI uses the PyDM framework, which can display the status of each crate and its components and can also display an alarm message. The alarm message shows position of the crate, the time and cause of the abnormal state to speed up troubleshooting. It has the potential to prevent the cPCI internal cards or EPIOC from malfunctioning due to abnormal conditions of cPCI crate.

We have developed the cPCI diagnostic tool, but there are many devices in the TPS control system hardware that are support by SNMPs. It is also necessary to monitor these devices. In the future, we will establish a diagnostic tool for each device type, such as UPS, network switch, etc.

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