Database Applications Development of the TPS Control System

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Abstract

The control system had been established for the new 3 GeV synchrotron light source (Taiwan Photon Source, TPS) which was successful to commission at December 2014. Various control system platforms with the EPICS framework had been implemented and commissioned. The relational database (RDB) has been set up for some of the TPS control system applications used. The EPICS data archive systems are necessary to be built to record various machine parameters and status information into the RDB for long time logging. The specific applications have been developed to analyze the archived data which retrieved from the RDB. One EPICS alarm system is necessary to be set up to monitor sub-system status and record detail information into the RDB if the problem happened. Some Web-based applications with RDB have been gradually created to show the TPS machine status related information. The efforts are described at this paper.

Introduction

- TPS Control system is based on the EPICS framework. EPICS toolkits provide standard tools for display creation, archiving, alarm handling, etc.
- Java-based EPICS data archive system had benn set up for the TPS project. Relational Database (RDB) has been used as the data storage mechanism for recording historic EPICS data.
- Taking the performance and redundancy into considerations, the storage servers and database table structures are tuned up relatively.
- Java-based alarm system have been developed as the alarm handler for the TPS control system. A distributed alarm system monitors alarms in a control system and helps operators to make right decisions and actions in the shortest time.
- Web-based machine status broadcasting is convenient to use with Web browser. Trend data are retrieved from the database, and also show variations on the Web-base machine status broadcasting.

TPS EPICS Data Archive System

- CS-Studio based archive system stores data in the RDB. The EnterpriseDB (PostgreSQL) RDB has been used for the TPS EPICS data archive system.
- PostgreSQL RDB is a good compromise and bigger table sizes. Both the historic data of PVs and the Archive Engine configuration are stored in the same relational database.
- Engine configuration is imported from an XML file format into the database.
- Software architecture is shown as Fig. 1. Storage system is separated into two databases which named RDB1 and RDB2.

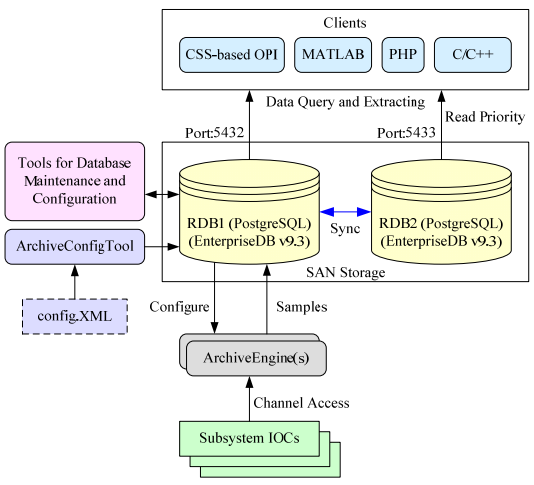

Fig. 1: Software architecture of the TPS EPICS data archive system.

- RDB1 is mainly used to store into the EPICS historic data from EPICS IOCs. RDB2 is synchronized to be a duplicate of RDB1. If the RDB1 causes service halt, the RDB2 will do replication mode for restoring to the RDB1.
- RDB2 provides higher reading priority to enhance transmission bandwidth for extracting queried historic archive data.

Database Tuning up for the TPS EPICS Data Archive System

- To easily maintain and manage the archived data of database, the sample data table has been separated into a lot of sub-tables by days. New EPICS sampled data have been inserted into the specific sub-table which is according to the day.
- If the older samples need to be deleted, the day-named table can be indicated and deleted. Each created sub-tables have been added the table index to enhance performance for data retrieving.
- Actually the test is that one week historic data (one channel-sample per second) need about 10~20 seconds to be queried out, extracting and plotting. Otherwise, there is about 1~2 minutes without creating the table indexes. It is effective to create table indexes to enhance performance for retrieval.

Operation Interfaces of the TPS EPICS Data Archive System

- Data Browser is a generic CS-Studio toolkit that combines Strip Tool and Archive Viewer functionality. It can display live samples as well as archived data in a plot, or export the data to files.
- CS-Studio based OPI can be used in difference operation systems, such as Windows and Linux-based.
- For the TPS commissioning and operation phases, the machine status GUI is necessary to be created for observing the historic variations for long time, such as beam current of booster and storage ring as shown at Fig. 2.
- During baking process of in-vacuum insertion device, the interface was displayed the latest 30 minutes historic temperature and vacuum data trend which retrieved from the RDB of archive system as shown at Fig. 3.

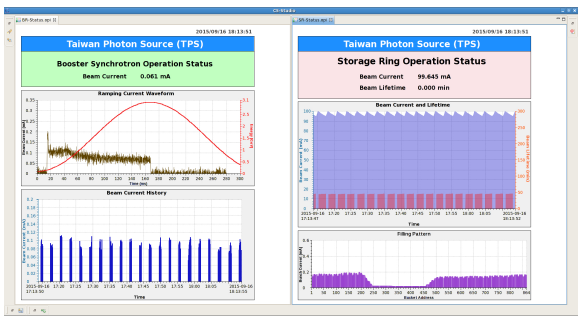

Fig. 2: GUI of CSS-based archive data browser.

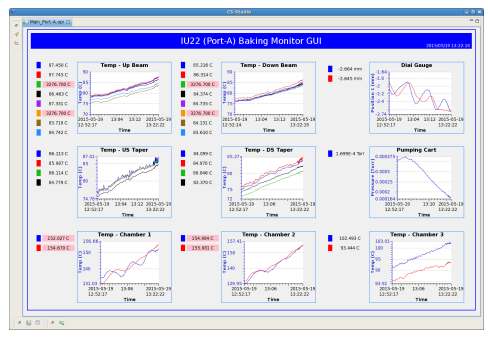

Fig. 3: Archive data browsing GUI for ID baking.

- The MATLAB toolkit has been used to analyze the RadFET threshold voltage archived data which retrieved from the RDB archive system directly. The MATLAB toolkit for analyzing the RadFET threshold voltage archived data is shown as Fig. 4.

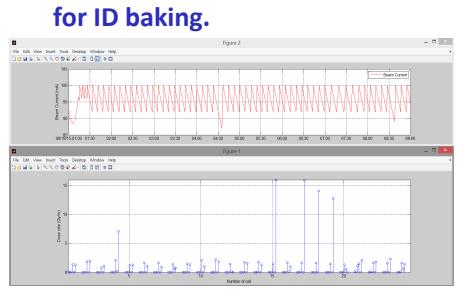

Fig. 4: MATLAB interface for analyzing RadFET archived data.

TPS ALARM SYSTEM

- The "BEAST" (Best Ever Alarm System Toolkit) of CS-Studio with MySQL RDB is adopted as the alarm handler for TPS as shown in Fig. 5.
- Each alarm is supposed to be meaningful, requiring an operator action. Each alarm requires operators to react because the control system cannot automatically resolve an issue.

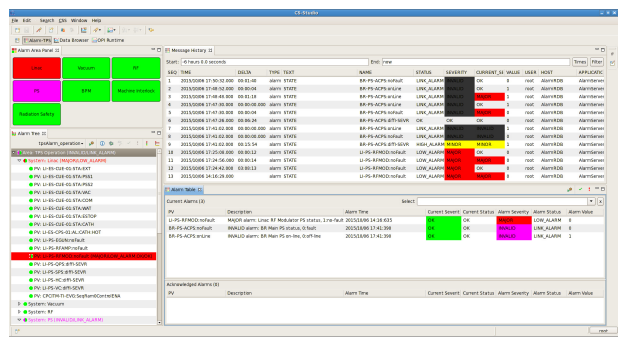

Fig. 5: CS-Studio based graphical interface of TPS alarm system.

Web-based Applications

- Trend graph is one of necessary components to show the historic variations of beam current and beam lifetime on the TPS machine status broadcasting. Trend data are retrieved from the RDB of TPS archive system by the PHP program as shows at Fig. 6.
- Olog solution has been selected for TPS electronic logbook. The progress of operation information has been recorded into the MySQL RDB.

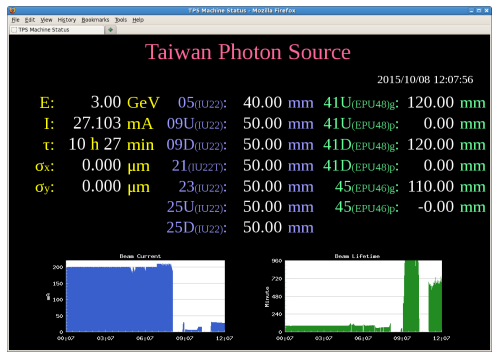

Fig. 6: TPS Web-based machine status broadcasting.

Summary

- RDB has been adopted as the data storage for the TPS archive system. Archived data are retrieved by use of the CS-Studio based interface or specific toolkits for special purposes.
- RDB alarm system has been built to help operators to make right decisions and actions in the shortest time.
- More database applications are in developing during the commissioning and operation phases.

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