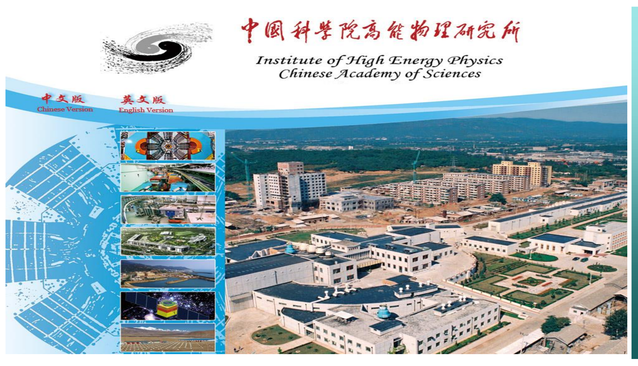

A New Data Acquiring and Query System with Oracle and EPICS in the BEPCII*

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INTRODUCTION

BEPCII has successfully built its control system with EPICS[1]. Besides using Archiver, a historical database with Oracle had developed for a long term storage. The data acquisition program developed by Python got the EPICS PVs from the EPICS IOCs. This program was scheduled by a back processing Cron. When it is scheduled timely, many CA were recreated and took too much times. As a consequence, the first schedule had been not finished, the next schedule had started. Many such data acquisition programs had been running in parallel so that the control network congestion caused EPICS PVs loss. Such kind of problem had happened many times since 2006. So, it is necessary to reconstruct a new historical database and data acquiring and query system with Oracle. Since EPICS has been widely applied to accelerator control systems, it's becoming a hot topic how to store EPICS PV data into a database for a long term storage. So, the purpose of this new system development is to be commonly used to EPICS control system.

THE OLD ORACL ESYSTEM

The old data acquiring and query system with Oracle consisted of three parts: data acquisition and Oracle database and data query (see Fig. 1 and Fig.2).

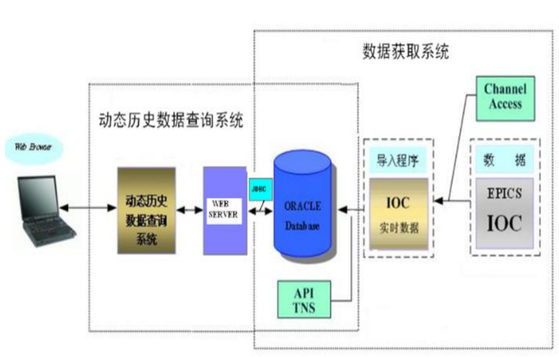

Fig. 1: The old Oracle System.

Fig. 2: the old Query System.

The data acquisition software programmed by Python got the EPICS PVs from the EPICS IOCs. It was scheduled by a Cron processing in Linux. It has the following disadvantages:

- Ineffective data acquisition sampling rate (once per minute). It took many times for the CA channels reconnection when it was executed.
- The program was repeatedly performed periodically. It means the next schedule has started when the first program had not been finished. Many same programs were running simultaneously so that the control network congestion caused PVs data loss.

The old data query system was in B/S developed using Java. The query interface is shown in figure 2. It has the following disadvantages:

- It's impossible to implement the correlated subquery between the subsystems.
- The database tables are designed into one independent table for each subsystem (e.g. power supply control system table and vacuum control system table and so on).
- There is no any zoom in function and data without time stamp display in the interface.

A NEW DATA ACQUIRING/QUERY SYSTEM WITH ORACLE AND EPICS

The new system including data acquisition and query consists of three part: data acquisition and Oracle database and query (see Fig. 3).

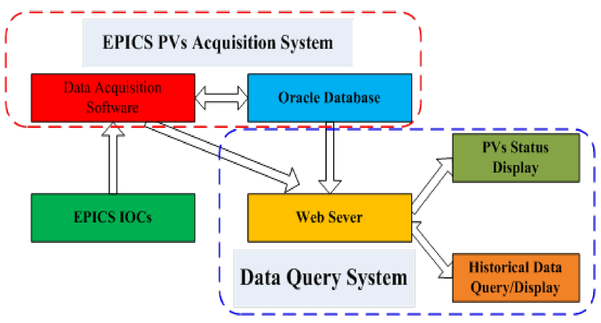

Fig.3: PVs access/query system

The new data acquisition system
After comparison on JCA and CAJ, we chose CAJ as the interface to EPICS IOCs and used a monitor method to get EPICS PVs, then send them to the Oracle database. This system is developed using JAVA on RCP platform. The data acquisition engine is shown in figure 4.

Oracle database model

More than 5000 PVs to be stored in the Oracle database are from EPICS IOCs of the different subsystems. There should be correlation between different data. So, we designed unique database tables: All_pv_list_tab and XX_tab. All_pv_list_tab mainly stored all PV static information, including name of PV, system name, alias, note, table, etc. XX_tab mainly stored PV concrete data, mainly including id, name of PV, PV date, PV value, including XX on behalf of the name of the system. All_pv_list_tab table structure as shown in table 1, XX_tab table structure as shown in table 2.

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Table 1: All_pv_list_tab table structure

Field name	Type	Description
PVNAME	VARCHAR2(50)	PV英文名称
SYSTEMNAME	VARCHAR2(100)	系统英文名称
LASTTIME	DATE	该字段保留
LASTVALUE	NUMBER(10,3)	该字段保留
DESCRIPTION	VARCHAR2(100)	系统中文名称
PVTABLENAME	VARCHAR2(20)	PV所在表名
MACHINES TATUSNAME	VARCHAR2(100)	PV中文名称

Table 2: XX_tab table structure

Field Name	Type	Description
ID	NUMBER(20)	主键
PVDATE	DATE	PV 时间
PVVALUE	NUMBER(20,3)	PV值
PVNAME	VARCHAR2(50)	PV英文名称

Due to more than 5000 EPICS PVs to deposited in the database, in order to improve the query speed of data, optimize the database performance, the data table on the first of all in the name of the PV primary partitions, and then conducted on PV time partition. All PVs with a month of data is stored in a table space. It's convenient to remove historical data and the maintenance of the system.

The new data acquisition system

The data acquisition software(see fig.4) using multithreading technology contains:

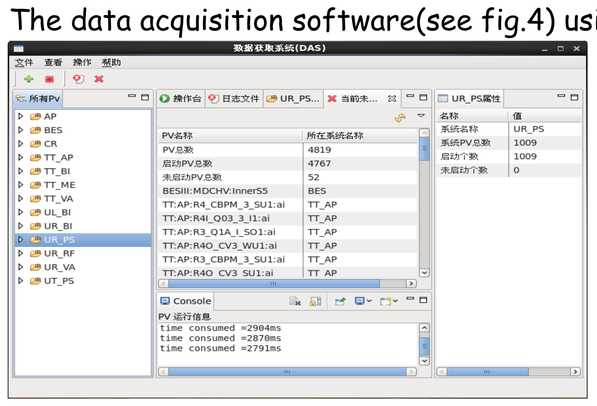

Fig.4: The data acquisition engine.

- Data acquisition thread.
- Data write thread.
- Data service thread.

This system has the following function:

- Data acquisition of start and stop.
- The recovery of PVs connection.
- Log management.
- PVs increases the wizard.
- PVs status view.
- Right control.

The historical data query system

The historical data query system takes EPICS PVs out of the database in the form of curve display on the web. This system mainly includes the web server program and web service, as shown in figure 5.

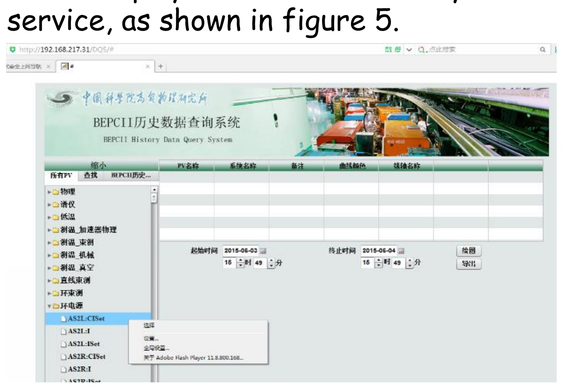

Fig. 5: The interface of the historical data query system.

The web server programs are written in Java, database interaction using JDBC. The web page display service programs contain historical curve and the data acquisition engine status page. The web history curve display is developed using the Flex, the main function is as follows:

- EPICS PV search.
- Query the date selection.
- Curve color choices.
- Longitudinal axis curve range of choice.
- Common longitudinal axis selection.
- Curve magnification.
- Curve with a little time message.

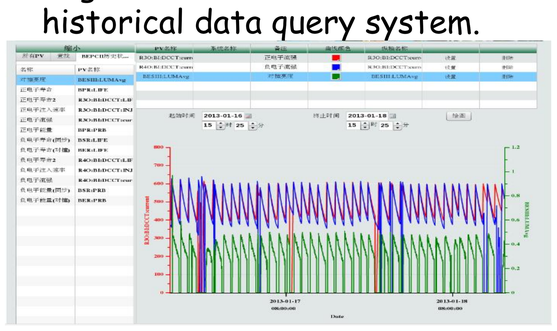

Fig. 6: The historical data query results

The historical data query interface as shown in figure 6, shows from 2013/01/16 to 2013/01/18, in collision mode within two days of the shape of the beam intensity and collisions brightness curve.

SYSTEM PERFORMANCE TESTING

The Jconsole provides memory, threads, such as CPU performance monitoring. It can easily find memory leaks and thread deadlock. Jconsole testing interface as shown in figure 8.

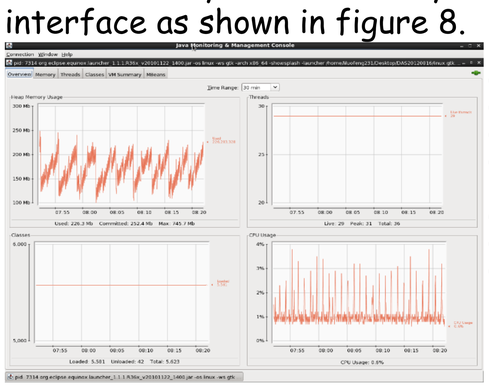

Fig. 8: Jconsole test interface.

The new data acquisition system test results are as follows:

- Data acquisition software runs stable.
- The minimum sampling time 2s.
- The biggest footprint of about 250 m.
- Data storage consumption time 1.5s (48 tables and 200 data into one table).
- No memory leaks.
- No thread deadlock.
- No thread deadlock.

At the same time, data query system test results show that:

- Access concurrency > 50.
- Page 4s drawing time (1 day, 3 PVs), 15s (15 days, 3 PVs) .
- Web services work duration > 190 days.

For the long time storage, we uses the minimum sampling interval time 1 minute feed into the database. So, 5000 PVs estimate 24 hours and need about 300 MB to 500 MB of storage space, including data storage and index files are stored.

From monitoring system, without any increase of PVs under the condition of invariable and access frequency, storage for one year is about 100 GB of data storage space. Compared with the old system 300 GB per year, it's significantly reduced and saved storage space.

CONCLUSION

The new data acquisition and historical data query system with Oracle and EICS has been trouble-free operation more than three years since July 2012. The new system is stable and reliable, and can completely replace the old ones. It can not only meet the needs of physical beams personnel, but also greatly convenient equipment operation maintenance personnel equipment fault analysis and diagnosis.