Data Acquisition System with Database at the SPring-8 Storage Ring

A. Taketani, T. Fukui, K. Kobayashi, T. Masuda, R. Tanaka, T. Wada, and A. Yamashita
SPring-8, Kamigori, Ako-gun, Hyogo 678-12, Japan

Abstract

The SPring-8 storage ring control system has two kinds of access to the machine components, that is, an interactive operation and a periodic reading/monitoring operation. This paper describes the later. The machine status are periodically taken by processes on VME CPU(named the poller) and stored into shared memory. A process(collector client) running on the operator consoles cyclically collects the latest data set through its server process(named the collector server) running on the VME system. The collected data sets are sent to the on-line database by the collector client. Most of the machine status are updated every 5seconds. Many processes on the operator consoles can get current status of the machine from the on-line database without requiring direct access to the machine components. This data acquisition system provides good performance monitoring hundreds of devices without placing significant load on the VME CPU and network traffic.

1 Overview

In the SPring-8 storage ring control, there are two ways to access machine components. One is an interactive read/write access and the other is cyclic reading to monitor machine status. During interactive access, the control command is issued by the operator workstations in the central control room and sent to the Equipment Managers(EM)[1] running on the VME CPUs through the Access Servers(AS)[2]. The EM manipulates the machine components and the results of operation are sent back to the workstations. Thia roundtrip takes 10msec for each command typically. This interactive access is suitable for real-time access to a small number of the machine components. On the other hand, cyclic data acquisition is more efficient when a large number of signals must be communicated.

The cyclic data acquisition system consists of three major parts: the poller processes, the collector servers (CS) and the collector clients(CC) (see Figure 1).

The poller processes on the VME CPU boards reads the equipments status from the I/O modules sequentially and stores it into a shared memory. With assistance from the collector server process on the VME system, the collector clients running on the operator workstations collect shared data memory and store it into the database[3]. The list of equipment status to be monitored is managed by the parameter database and downloaded to the appropriate process.

2 Poller

We have developed the EM to support an interactive access with the device abstraction concept. The poller is developed with the same framework and function set as that of the EM. The interactively working EM receives the commands through the network with the remote procedure call(RPC), on the other hand, the poller is a process to call the EM locally.

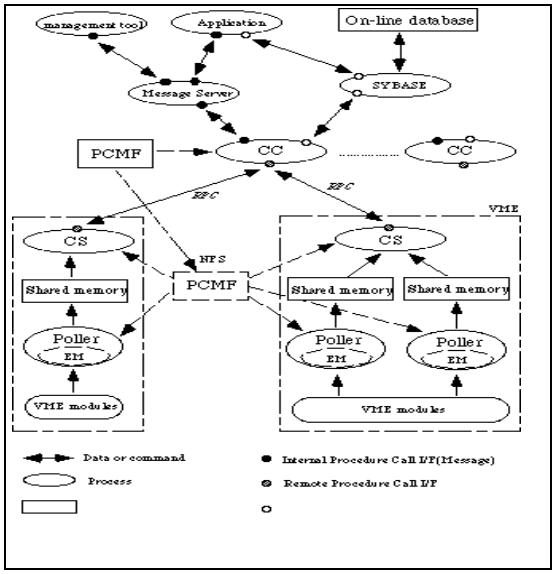

Figure 1. Schematic diagram of the poller/collector data acqusition system.

Several number of pollers are able to exist according to its cycling speed. Ordinarily we use two pollers at the maximum, that is, the fast poller and the slow poller. It is convenient with the different access speed because the VME system has both of slow access components such as GP-IB controlled DVM and fast components. The pollers are installed on the CPU either fast poller only or both fast and slow pollers according to the VME board configuration.

2.1 Poller/Collector Management File

The poller stores the command list to be carried out in the local memory space. At the initialization of the process, these commands are loaded from the Poller/Collector Management File(PCMF) which is generated from the database. Since the operating system of VME CPU(HP-RT) can not access the database directly, the PCMF is used to get the informations on the database. An example of the PCMF is shown in Table 1.

The PCMF is generated for each VME CPU and it has the informations as follows:

- the CS name communicated with the CC,
- the poller name forked by the CS,

- the cycle of the poller,
- the signal names to be taken and the corresponding commands.

As can be shown in Table 1, two poller processes are forked from the CS named "srrfcavbcs". One poller named "srrfscavbpl1" takes 2 signals with 1sec period, and the poller named "srrfscavbpl2" gets only one signal with 60sec period.

2.2 Polling Procedures

The poller refers the loaded command lists, gets the abstracted commands, and calls the corresponding EM functions sequentially in order to get the equipment status. One polling sequence is defined as the sequential execution of all commands in the lists. The poller repeats the polling sequence in the cycle time given by the PCMF. The definition of the cycle time is the period between the start of the first polling sequence and that of the next one. When the consumed time is less than the given cycle time, the process sleeps up to the next data taking time. Otherwise the poller starts its data taking immediately.

The status data is stored into the shared memory which can be accessed by the collector server. The shared memory forms ring buffer structure, that is, the newest data set is overwritten onto the oldest one.

2.3 Priority Control

Generally the periodic machine monitoring should not be prior to the interactive control from the operator consoles. On the other hand, in cases of device access with locking mechanism, the poller priority must be same as that of the interactive EM in order to avoid the dead lock. The poller can change its running priority with the feature of real-time operating system.

After the poller starts running, its priority is dynamically changed to be lower than that of the interactive EM by itself. When the poller accesses the device with lock, it changes the priority to be higher same as the interactive EM. After the access, the poller unlocks the device and degrades its priority.

For example, during changing the hundreds of the magnet current via the EM, the poller on the same CPU runs with slower speed.

2.4 Checking the Poller Status

It is important for the process surveillance to check whether the process is running or not. The status of the poller is checked whether the stored data in the shared memory is updated or not. In data taking sequence, the poller gets the HP-RT system time and sets the time stamp in the shared memory as the one of the status.

Table 1. An example of the poller/collector management file(PCMF).

```
==========================================
=
<collectorserver>id=7,name=srrfscavbcs</collectorserver>
<poller>id=7,cycle=1.0,name=srrfscavbpl1,table=/prj/bin/rfscav_b
/poller_fast/config.tbl,ringsize=10,exec=/prj/bin/rfscav_b/poller_fa
st/pc_po_main,serverid=7</poller>
<signal>id=20144,pollerid=7,type=int,kind=2,signame=sr_rf_circ
ulator_tcu_b/alarm</signal>
<signal>id=20145,pollerid=7,type=float,kind=1,signame=sr_rf_cir
culator_tcu_b/current</signal>
<poller>id=20,cycle=60.0,name=srrfscavbpl2,table=/prj/bin/rfscav
_b/poller_slow/config.tbl,ringsize=10,exec=/prj/bin/rfscav_b/polle
r_slow/pc_po_main,serverid=7</poller>
<signal>id=20088,pollerid=20,type=float,kind=1,signame=sr_rf_c
av_body_1_b/temp</signal>
==========================================
=
```

3 Collector server and client

The machine status is taken and stored into the shared memory in the VME CPUs. The CC running on the operator workstations periodically ask the CS on the VME CPU to get the latest data set on the shared memory.

The CC sends the data to the on-line database through the database libraries. The cycle time of storing the collected data to the database is defined in the parameter database. The CC reads this cycle from the parameter database directly at its initialization step. The CC also reads informations such as the CS name, host name of the CS to be connected, the number of signals to be taken and so on.

Once the data is stored into the on-line database, they can be shared among many processes running on operator consoles without direct machine component access bothering the interactive control.

One CC can make multiple connections to the CSs. We make groups such as RF, magnet, vacuum, beam monitoring, and safety in order to realize independent operation of different groups. Each equipment group has one CC and several CSs.

Since the size of the data is depend on the machine configuration, the variable length data format is adopted for the data transfer from the CS to the CC.

3.1 Shared Memory Dump Utility

As already mentioned, the poller has a ring buffer. There are several data sets with different time stamp on the shared memory. It is useful to have an utility to dump the all ring buffer contents into a file. This utility is performed by sending the command to the CC then the corresponding CS dumps the all data on the shared memory to the specified file through the NFS. If the size of the shared memory is large enough, the dumped data can be used to investigate the source of the machine troubles in the off-line analysis.

4 Conclusion

The SPring-8 storage ring control system has been succeeded to operate with the poller/collector data acquisition system since March 1997 without major failure. Most of the machine status are stored into the on-line database in every 5 seconds. These data can be accessed by any processes on the operator consoles. The poller/collector data acquisition system provides good

performance to monitor more than hundreds of equipments with the minimum load of VME CPUs and network traffic.

Currently poller/collector system is also installed to the beamline control. The data from the insertion device system such as the gap position, beam position monitors, current of corrector magnets are stored onto the machine database successfully.

References

[1] A.Taketani et al., Proc. of ICALEPCS'95, Chicago, USA, 1995, p. 625.

[2] T.Fukui et al., "Design and the network system for the storage ring control at SPring-8", these Proceedings, ICALEPCS '97, Beijin, China, 1997.

[3] A.Yamashita et al., "The database system for the SPring-8 storage ring control", these Proceedings, ICALEPCS'97, Beijin, China, 1997.