PRESENT STATUS OF SSRF CONTROL SYSTEM

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Abstract

SSRF(Shanghai Synchrotron Radiation Facility) is third generation light source with 150MeV Linac, 3.5Gev Booster and Storage Ring. SSRF control system is a hierarchical standard accelerator control system based on EPICS. The VME 64X system and PLCs are used for various low level devices control and interlocks system. Serial device servers were used to connect serial devices and instrumentation to the Ethernet. All control sub system are been under construction. System development environment of hardware and software has been set up. Most of sub systems model have been set up and are being tested with devices on schedule, like digital power supply control system, event timing system. The high level physical application environment has been set up and done the online test of device control using MatLab with Accelerator Toolbox (AT) & middle layer. With the SSRF centre database, a set of tools such as configure tools and alarm handler have been set up. An enhanced distributed archive engine store data to centre database and using native XML data type with xml schema for data storage. The LINAC control system have been completed and used for its operation. The Booster control system successful used for the commissioning of Booster on the Oct. 1.Various testing result of control system for SSRF equipment will be described in this paper.

ENVIRONMENT

The development and runtime environment of control system have been set up and come into use. It composed with the network system, server system and OPI system. Developer and operator can login in on any terminal and share resource of entire environment with one account system.

Control system network

SSRF using the 1000Base-T control network instead of field bus for mostly device controller, like the PLC and lot of serial based device (using protocol translate: serial to Ethernet translator), most of device are connected by the control network directly and integrate with EPICS using soft IOC. The soft IOC can be managed by multi IOC running configure system. The backbone redundancy design was adopted to ensure the network reliability. Main switch using 3 layers device and others using 2 layers. Various subsystem are running on the each subnet separated by VLAN (Virtual Local Area Network) with flexible.

Uniform running and development environment

Set up the uniform development environment which base on PC Linux system for development and operations. All of the OPI and the server system running the fedora 7 system for supply the EPICS development and high level physics application environment. Using NIS and NFS to manage user account and share resource. As part of runtime environment, the database server, boot server, Soft IOC server and EPICS application server such archive and alarm handler were installed at the server room.

Several versions (from 3.13.x to 3.14.8.2) of EPICS base with cross-compiler support were installed. One the runtime environment the base 3.14.8.2 is confirmed. Mainly we use the target machine is Motorola VME5500 and GE7050 which is defined in EPICS as architecture of ppc-604_long. The directory structures were defined for the whole environment, like "/usr/local/epics/base-3.xx.xxx" for epics base.

The extensions have includes all the tools we needed. In fact, we install all the EPICS tools like sequencer,ALH, EDM, MEDM, archive engine and so on. Developer can use to development all their applications

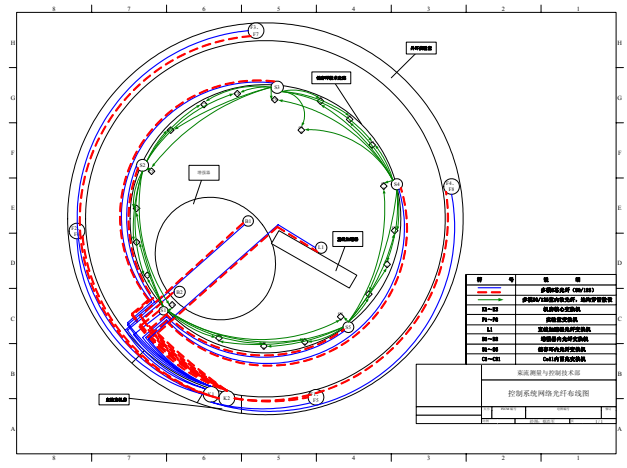

Figure 1: Main layout of control system network.

STATUS

All Subsystem control schema for the machine were confirmed and tested prototype make the control system environment. As yet, The LINAC control system has been delivered for operation and works fine. Now the LINAC was completed commissioning and can running normally. For the Booster control system, have finished device install and online test procedure, the hardware and software system success used for commissioning injection from LINAC to Booster and got first beam stored beam in Booster. Most function of control sytem are implemented . The device installation of Storage Ring on installation process.

Hardware system

For convenience reason of the system manage and maintenance, control system hardware system adopt an unitary design, as typical implementation of SSRF control system, it have:

- VME 64x System using GE VMIVME-7050 and Motorola MV5500.
- PLC system: Yokogawa FM3, SIEMENS S300.
- Serial port server MOXA NPort-5620.
- The embedded controller: digital power supply controller
- VME-EVG-230, VME-EVR-230, EVR-TTB-200, EVR-OTB-200

Table 1: IOC List

System	Device	IOC	PV
Power supply	800	26	29610
Vaccum system	730	25	29200
MPS system	25	3	1000
Timing system	16	16	540

Table 1 show the IOC and PVs of main sub system. Include hard IOC(VME) and soft IOC(), Have tested all of hardware such as VME system, PLC, Serial port server and have prepared, done all related EPICS driver testing

Software system

The SSRF control system running on EPICS base 3.14.8.2, at OPI, EDM and some strip by Python was used in OPI. For high level physics application

Data archive system use RDBMS for data storage and data management. We using the distribute archive engine. See Fig 5. The archive engine using XML engine configure and native XML data type of database withXML schema. The engine run on Linux Fedora 7 with distributed form (multi-engine). Database connected by ODBC, on our case we use Free TDS 0.63. All the data can be access by the Web Service data access interface (Fig. 2). This platform independent data analyse interface can be called by windows client, LINUX client, Matlab and strip like python. Now it was already done and in testing process.

Centre database system

SSRF use centre database to store the machine parameters and reference information for all stage of machine simulation and running. The database system support access and set various accelerator run time configure parameters, failure report and invalid record of all system. It also store data of accelerator on time using channel archive system, also can be used for analysis by users. The centre database system integrate with uniform authentication system, uniform database access rule and data integrality. Remote access from Internet and web based database access also could be applied. The hardware platform using SAN & database server cluster. Now we have tested on the MS SQL Server 2005 and will transfer to Oracle 10g with RAC later.

DEVICE CONTROL

Most of device control system was finished installation and online test, include power supplies control, vacuum system, injection/extraction system, timing and MPS system. Something like insertion device control is in process.

Digital power supply control

There are over 800 magnet power supplies (PS) in the Storage Ring, Booster, Linac and Transport Lines. For the requirement of control precision, reliability and stability of the magnet power supplies, digital PS control system was used. The typical resolution reaches 1ppm to 10ppm with long term stability, reproducibility is better than 30ppm. There are two kind of digital control card s, the PSI Digital power supply controller and designed digital power supply controller in house. Each PS has a local digital controller and a optical link. The VME-based front-end consists of a Single Board Computer, IP carriers and Industry Pack (IP) I/O modules. A Prototype has being developed and the software and hardware solutions have been tested. Basic functions, including waveform (using internal trigger), have been tested.

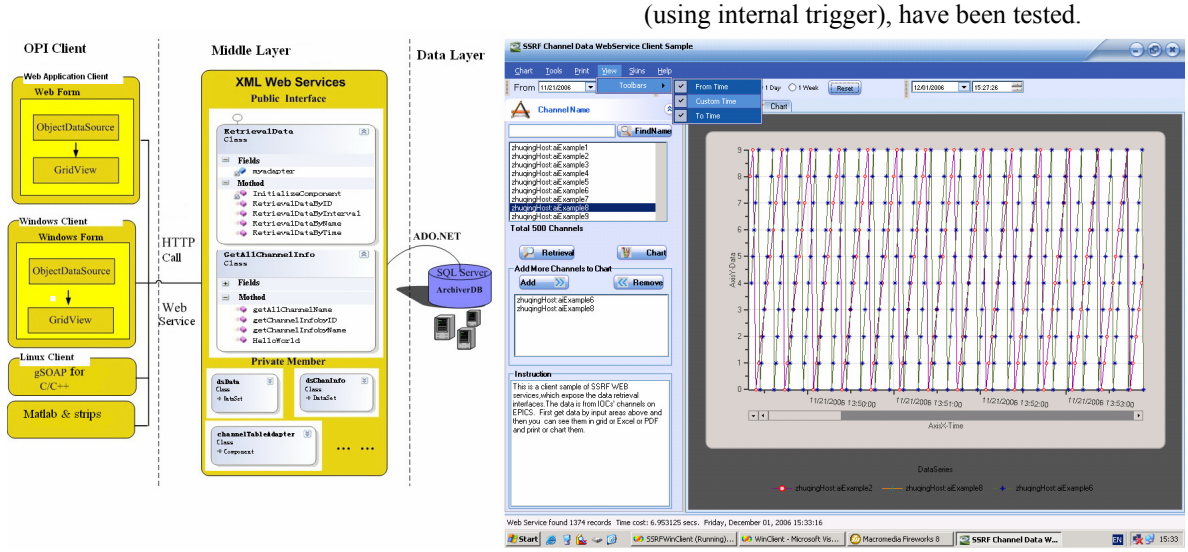

Figure 2: Archive data anylisy system based on web service.

Vacuum control system

There are above 730 vacuum device installed at the whole machine. VARIAN Multi Gauge. JJJvac Sputter Ion Pump Power Supply, Vacuum Valve, RGA（Residual Gas Analyzer）, except Vacuum Valve, all of these device are serial port based, the MOXA serial to Ethernet translate be used for serial device and using Soft IOC. All of the vacuum device data can refresh at 10Hz rate.

Timing system

Adopt the New event timing system refer to APS event system, SLS and Diamond timing system. Advantage of new timing system

- Structure is simple used broadcasting method
- Low Jitter with distributed RF clock
- It can be run on the EPCIS environment
- Easy to extend

Now this system integrated with EPICS base 3.14.8.2 is running well for Linac and Booster. The figure 3 show the timing distributed structure. Timing triggers have been success used for Gun of LINAC , kickers and septum of Booster with low jitter and precise control.

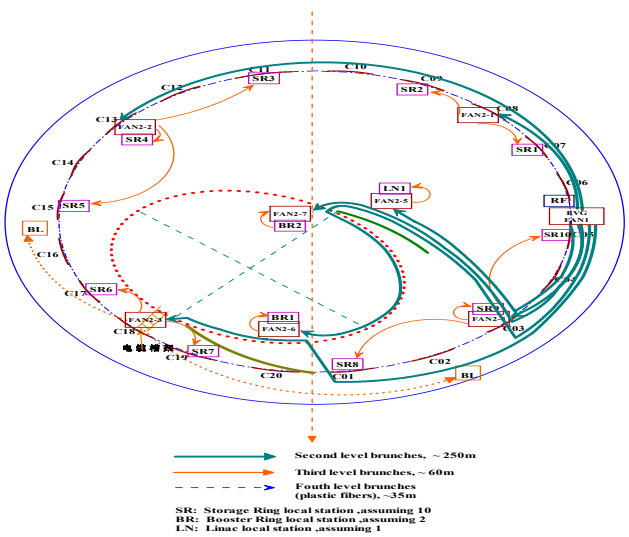

Figure 3: Timing system lay out.

MPS system

SSRF MPS system implement with a PLC system that composed with 25 sets of Yokogawa FM3 PLC. In order to ensure the reliablity of MPS system, all the interlock logic run at PLC layer and integrated EPICS for monitor and event record using NetDev by KEKB. The whole system has 4 layers: Accelerator system layer interlock, Sub collectivity layer interlock. The MPS interlock logic is finished designed and now the MPS system is running at Linac and Booster.

OPI system

SSRF use EDM for the machine operator and use Matlab version 2007a, Accelerator Toolbox (AT) & middle layer AT for high level physics application. As descript in the section of environment, all the OPI run on the lLINUXFedora 7. The EDM file store on NFS file server and all the client can access it by a start stript. Fig. 4 show some OPI panel of SSRF control system.

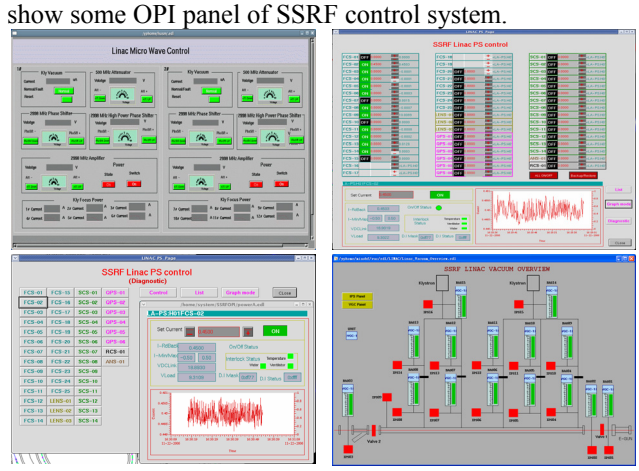

Figure 4: OPI panel of Linac control system.

CONCLUSION

Set up a distributed controls system based on EPICS. Almost device control system had finished system construct, include install, online testing and software development. The LINAC control system already run 5 months already, Booster control system are used for commissioning Booster now. The control of Storage Ring was under construction. High level physics application and OPI panel can run normally. To end of this year, the control system will launch into the machine commissioning. In general, most function of control have been reached on design goal, the detailed specification are testing.

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