The CDR of Computer Service System for SSRF Project

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Abstract

Before the year 2000, the SSRF (Shanghai Synchrotron Radiation Facility) project is the largest scientific project to be approved by Chinese Government in CHINA. It consists of a 100MeV LINAC, 2 GeV Booster and Storage Ring. The R&D of SSRF has been approved by the Science and Technology group of the Government. Most of the Pre -Research and Design (R/D) will start early of next year(1998). The location of SSRF project will be selected soon. This paper will describe present progress and its computer service system including computer network, accelerator control system, beam diagnosis system, computer simulation system, user service system for light beam line and office automation for a new lab-Shanghai National Laboratory of Synchrotron Light Facility .

1 Introduction

According to the physical requirement of scientists from many research fields, a new proposal for a light source was prompted in the 1995 Spring under the Shanghai Government and Chinese Academy of Science . In the September,1996, the International review meeting for SSRF was held in Shanghai, China.

2 Design philosophy

- Reliability, in general: if the total down time is less than 5% of running time, then the users will smile. However, the computer system is low level equipment so it's fault rate should be much less than 1% to 0.1% .
- Advanced technique: The computer technology is developing rapidly, and the their cost decreasing day by day. We should consider this factors in selecting our computer architecture so that it can keep enough capability at the early part of the next century .
- Standardize and commercial products: According to the limited resources and manpower in the recent China. Select of standard commercial and industrial products as much as possible.
- High ratio of performance /cost: we should select those with a high ratio of performance /cost because of the limited budget.
- Cooperation with other labs on the world. There are around 30 Labs of light sources in the world. Their experience and technique would be much helpful for our design and construction of the SSRF project.

3 Main performance of SSRF

Item	Parameter
Energy	2.2GeV
Circumference	~300m
Beam Current	300-400ma (multi bunch) >5ma(single bunch)
Emittance	3~4rad
Bunch Length	~30ps-50ps
Beam lifetime	>8hrs
Beam position stability	+/- 10 μm

4 Computer system architecture

The entire computer structure is illustrated as follows. It will be composed of a control system, user service system of light beam lines, beam diagnostic and data analysis system including the 3D CAD , simulation laboratory, and office automation see Fig1.

4.1 Selection of network architecture

The network technology has rapidly changed from early Ethernet, Token Ring Fast switched Ethernet, to the ATM etc. In general, the bandwidth of the network is required to be wider. Now, we just can choose a category of them which is advanced, and extendible. The GIGAswitch/FDDI and GIGAswitch/ATM of DEC company can be used as one of solution[2]. So far, the technique of FDDI is widely adapted in many labs as the main backbone of the network. The GIGAswitch/FDDI crossbar switch is an intelligent, high speed switching bridge allowing multiple dynamic FDDI links to achieve unprecedented connectivity and LAN throughput-up to 3.6Gb/s aggregate bandwidth. It can provides up to 6.25 million connections per second; 100Mbps-full duplex; According to analysis of the market for the forthcoming 5 years, ATM technology will be adopted as industrial standard, it will be widely used for applications such as multimedia, graphic processes, video signal broadcasting etc. So the second solution of our network structure is that the main backbone will be on ATM network. The high-performance ATM GIGA switch provides guaranteed bandwidth with zero cell; 10.4Gb/s crossbar switch, scaleable from 155Mb/s Sonet/SDH port. However, ome factors such as its standard are not fixed, its cost is still higher. So the first choice is FDDI with extendibility to ATM when needed.

4.2 Selection between Unix and Windows NT

The UNIX OS have occupied the OS market with its powerful function and high stability for 25 years already However in the past 5 years, Windows of Microsoft company have rapidly developed from the personal PC world to the business field with its powerful flexibility,

low cost, and easy of learning, there are more resources for developing software on its various platforms such as Windows 3.x, 95 and Windows NT 4.0 (beta 5.0 version will issue soon). The amount of Windows's users

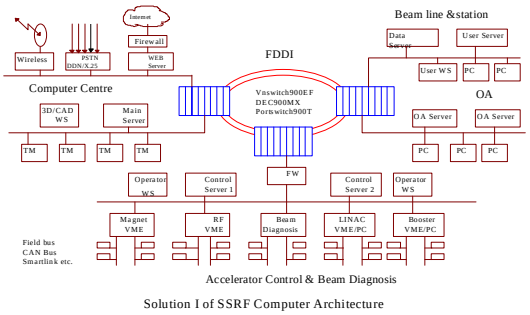


Fig1. solution of SSRF computer architecture

reached 40 million already. The simplified table illustrates their status see table1 as follows:

Table 1 The comparison between Windows NT & UNIX

No	Item	Windows NT	UNIX
1	copyright fee	3.82	3.49
2	management	3.78	3.11
3	feature	3.64	4.27
4	reliability	3.47	4.33
5	support for DB	3.47	4.30
6	support for business	3.28	4.13
7	rate occupied market	38.8%	37.7%

According to table1, our selection is that the high lever field such as the main computer, server still adopt the Unix, most of Server should use compatible hardware for both OS such as Alpha series server. However, the low level, such as division level could use Windows NT, the real time environment could select the RTOS such as VxWorks, or VRTX .

5 Control system

5.1 The goal of control system

The SSRF machine is middle size accelerator with around 20,000 control points. The most requirements are similar with other labs of synchrotron light source. The system reliability, long time stability and high ratio of performance /cost should be placed as a first priority of consideration.

5.2 Hardware structure

The entire hardware system is divided three hierarchical levels: level I is composed of the main control network, console, workstation, servers. Level II is composed of various subsystems such as magnet power supplies, vacuum system, RF system, beam diagnostics and cooling system etc. In this level, the VME system with real time OS could be used for data acquisition and data preprocess. VME is popular equipment in the high energy physics field. It can run with high stability and reliability as an industrial standard. However, our budget is limited, so we should find out other way to resolve this problem. The reliability of PC-based modular industrial computers has improved under ISO 9001 certification and passed many testing such as EMI (Electricity Fast transient)-EN50081-1,2; MTBF-Mil-HDBK-217f etc.. So we can adopt some modules based -PC (such as ADVANTECH's ADAM 5000seris) in the low speed field. The level III is intelligent controllers embedded into various equipment with a field bus adaptor.

5.3 Field bus

In general, most of controlled equipment is located along the accelerator with in several hundred meters. The serial CAMAC, Mil-1553B, bitbus, CANbus, GPIB, and communication standard RS232, RS422, RS485 are widely used for the past 20 years in the control world of high energy physics. The CANBus uses a bit-wise, nondestructive arbitration method to resolve any conflicts if two or more nodes try to access the network simultaneously. This process will not result in the loss of data or bandwidth. This feature resolves collision conflicts and determines a "winner", without loss of throughput or forcing the higher priority node to re-send its data. Higher priority data gets the right-of -way to be transmitted. The CAN system thus meet the requirements of real time applications refer to Fig2.

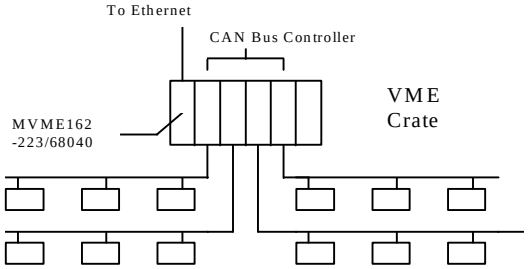


Fig 2. structure of Field bus

5.4 Timing and synchronization

Due to the ns beam pulses transmitted from the electron gun into the booster bucket, and storage ring. The system jitter time should be less than 200ps. Because of this, we should pay attention to deal with various connection of trigger signal passing through high EMI environment.

5.5 Interlock system

The machine protection and personal safety is very important for whole working area. PLC technology is suitable for this purpose because of its reliability and reasonable cost.

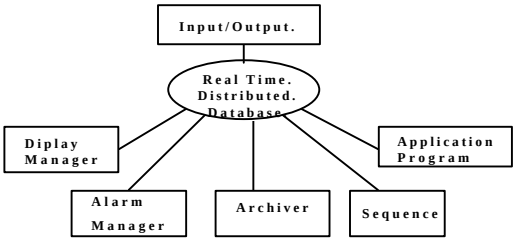
5.6 Software system

We are facing two choices for our system software, one is industrial products, the other one is non-commercial products. After comparing their features including its performance, cost, second resource, maintenance service, and considering our realistic situation with the SSRF

project. Fortunately, EPICS have been developed successfully for many years in many accelerator Labs. EPICS is a set of software tools and applications jointly developed by Argone National Laboratory and Los Alamos National Laboratory for the purpose of controlling accelerators and large experiments.

EPICS includes operation interface (OPI) which consists of multi-screen UNIX workstation using a graphical user interface (GUI) based on the X-windows Motif model. Also the EPICS has been developed on the PC which will be easy to work on China.

WindRiver′s VxWorks5.3 and Microtec′s VRTX/OS both provide excellent, full featured RTOS offerings. Both are based on similar kernel technology, with kernels which are modular due to their library style architectures. Both kernels provide state-of-the art features such as pre-emptibility and priority inheritance. They have own advantages and disadvantages. We will select them as our Real time OS as judged by performance, application environment and cost.



There are many application software for operation of the accelerator, such closed orbit calculation, ramping power supply of magnets.

6 Beam control and diagnosis

Various beam parameters of the accelerator are very important for machine running. In order to monitor beam characteristics we will set up approximately 10 category of beam instrumentation shown in table 2.

No	Item	Qty
1	BPM	220
2	DC current	1
3	Stripline	3
4	Profile	12
5	Wall Current1	1
6	Beam loss	1set
7	Beam current	10
8	photon beam steering	1set
9	Bunch feedback	2set

The most of the signals from the beam instrumentation have fast characteristics [1] so we will adopt fast pre-process electronics and digital signal processors (DSP technology). Those fast signals thus converts in normal FECs. The NI′s (National Instrument company) Labview or Lab windows is useful for beam diagnostics and various beam line station for their data acquisition and processing. It is easy to link with many interface such as GPIB, CAMAC, PLC VME/VXI. We have developed a prototype [3].

7 Office automation--groupware

Coordination is needed between staffs of the SSRF project. Due to the SSRF project is a modern complex scientific project. Many messages needed to transfer between different divisions and designers. So the Groupware (or Intraware) system should be adopted. At the present time, the Domino 4.5 Lotus Notes have been widely used on the most of 500 biggest enterprises in the world. So far after testing three kind of Groupware, Lotus Note 4.5, Microsoft′s Exchanger server and Novell′s GroupWise.

The Lotus Notes still ranks first. It supports the Windows NT/95, NetWare, OS/3 and Unix platform. Also it provides function of the personal Web Navigator which can link many team members distributed in the world. We are setting a prototype of Notes now see Fig.3

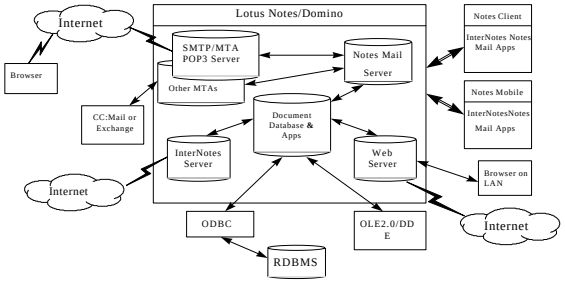


Fig3.Groupware for Office Automation

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8 Conclusion

The SSRF is the largest scientific project in the end of this century in China. Computer technology is developing rapidly, we should cooperate with other Labs in the world. We sincerely hope to get valuable suggestions from other labs.

Acknowledgment

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Reference

[1]Shanghai Synchrotron Radiation Facility Conceptual Design Report(Draft)

[2]Total solution for PC-based Industrial Automation ADANTECH solution guide Vol.71

[3]The Virtual Instrument Control System on this conference

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