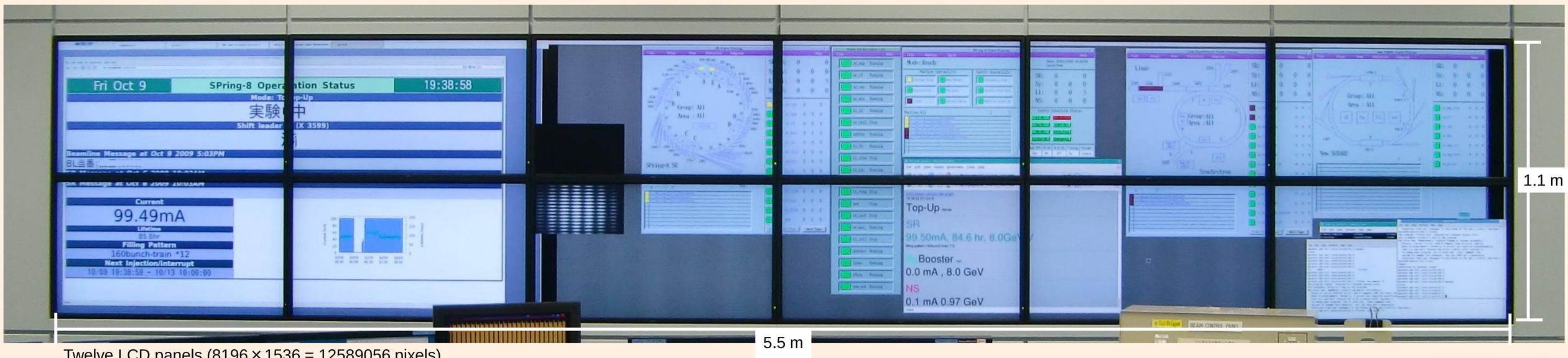
Development of High Resolution Large Display for SPring-8 Central Control Room

T. Hamano, R. Fujihara, A. Yamashita,
Japan Synchrotron Radiation Research Institute(JASRI) / SPring-8, Hyogo-ken, JAPAN



Twelve LCD panels (8196 × 1536 = 12589056 pixels)
NEC Display Solutions, Ltd. Multi Sync LCD 4020
- 40 inch
- 1366 × 768 pixles

INSTALLATION IN THE CONTROL ROOM

Based on the success of the prototype machine, we constructed a large, high-resolution display wall in the SPring-8 Central Control Room. The display wall consists of twelve LCD panels that are controlled using a personal computer (PC) cluster. The panels are arranged into a 6 x 2 segment to achieve a display resolution of 12 million pixels (8196x1536 pixels). A PC cluster consists of six PCs interconnected over Gigabit Ethernet. One PC cluster node controls two 40" (1366x768 pixels) LCD panels. We adopted Rocks Clusters as the control software. A software program handles the 12 displays through one X Window server.
In addition to its superior performance, Rocks Clusters afforded the following advantages:
- Easy to install, Easy to manage and control, Easy to reinstall the OS in case of problems.

One tile node machine controls two LCD panels through an NVIDIA GeForce GTX 285 graphic controller. The contents of each operator console can be displayed on the display wall using Virtual Network Controller (VNC) to share information between operators. A Real VNC implementation can increase or decrease the display size for smooth operation.

Display wall machines
- CPU:Intel Core i7 2.93GHz
- Memory:8GByte

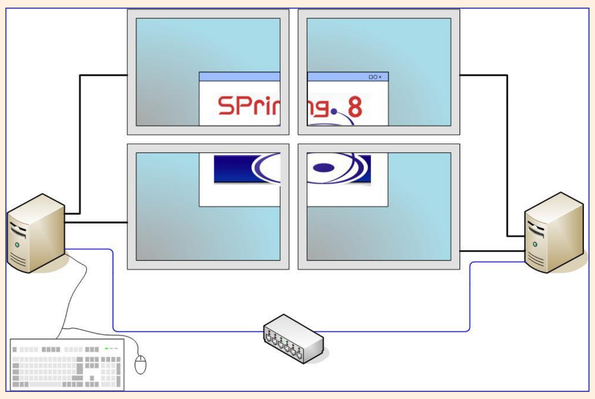
Side view

INTRODUCTION

Previously, four plasma panels were being used to display the accelerator and alarm status in the SPring-8 central control room. Those display had resolution of 1280x768 pixels in 50" size panel. They displayed alarm and accelerator status independently, so they cannot windows larger than one display. We decided to develop a larger, higher-resolution display wall to display more information. For example, sharing operator console displays would enable smoother operation. We searched for commercially available solutions that would satisfy the following criteria.

1. High resolution: The display wall must display the entire operator console display that has a resolution of 8196x1536 pixels.
2. Size: The display must be larger than 600 cm and its thickness must be less than 50 cm.
3. Brightness.
4. 24-h operation.
5. Single-display operation.
6. Low cost.

However, we were unable to find solutions that satisfied these criteria. For example, rear projection displays have poor resolution, large size, and high cost. A front projector has insufficient brightness and short bulb lifetime. Therefore, we decided to manufacture our own large, high-resolution display using inexpensive LCD panels to satisfy the abovementioned criteria.

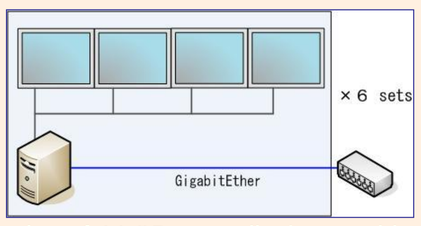


Control using one keyboard and one mouse.

PROTOTYPE MACHINE

Before deploying the real machine, we constructed a prototype display wall that consisted of 8 x 3 20" LCD panels to achieve a display resolution of 46 million pixels. One machine is connected to four display panels using a graphic device that can control four displays. A machine consists of six nodes.

Twenty four LCD panels
SAMSUNG SyncMaster 204B
- 20.1 inchi
- 1600 × 1200 pixles



Connection of 4 LCDs to a display machine.

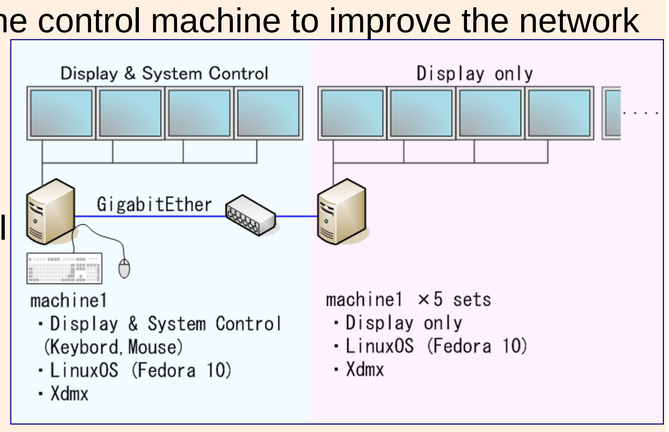
Development

We compared two software programs-Xdmx (Distributed Multihead X) and Rocks Clusters.

1. Xdmx + Linux

We controlled the display wall using Linux (Fedora 10) and Xdmx Version 1.3.00. Xdmx handles the six network machines through one X Window server. We installed Fedora10 and Xdmx on machine1, and connected keyboard and mouse to a machine out of six machines. One machine is operated in Fedora 10 Linux and uses NVIDIA NVS440 for graphic board. One NVS 440 are able to be connected to four LCD panels through DVI(Digital Visual Interface) interfaces. We successfully displayed one X Window over 24 displays using Xdmx. However, the display speed was unsatisfactory. This may be attributable to the network performance of the control machine. The control machine controls all other nodes, and therefore, it has to handle heavy network traffic. We added a fast network interface card (NIC) to the control machine to improve the network performance. Two-port bonding (link aggregation) was used for load balancing.
We measured the throughput among the display machines from the control machine.
- Physical port: 188 Mbps(average)
- Bonding port: 298 Mbps(average)

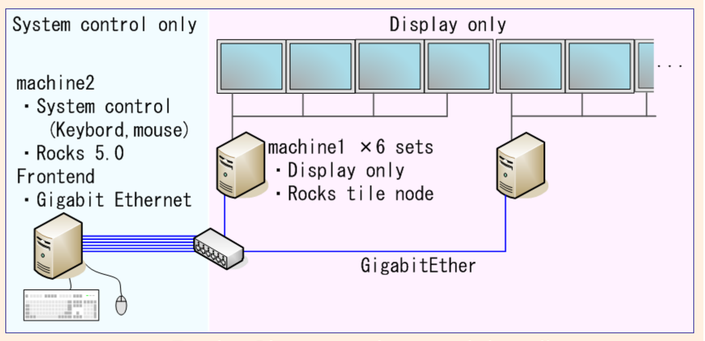
However, did not feel improvement of the speed on display wall machine.



Fedora 10 and Xdmx installed on machine1.

2. Rocks Clusters + Viz Roll

Another attempt was made on Rocks Cluster 5.0 and optional packages Viz Roll 5.0. Rocks Cluster software is PC cluster tool. This tool was developed based on the CentOS 5 by University of California, San Diego (UCSD). Optional packages Viz Roll 5.0 is multi head display tool to configure the screen. Rocks employ a dedicated machine as a controller. We installed Rocks Cluster server (front-end) on the control machine and Rocks Cluster client (tile node) on the six display machines. Rocks Cluster can be set up more easily than Xdmx because it integrates the OS and add-on packages. We successfully displayed one X Window over 24 displays using Rocks Cluster and Viz Roll. To balance the network traffic, we installed seven NICs in the control machine. One port was used for external communication, and the other six ports were used for point-to-point connections to the display machines using vlan with an intelligent switch. We measured the time required to display a large JPEG image(12561x3350 pixels, 11 MB). Xdmx required approximately 20 s, whereas Rocks Cluster required only 2 s. Therefore, we found the display speed of Rocks Cluster to be satisfactory.



Rocks Cluster and network bonding.

CONCLUSION

We controlled and integrated multiple displays as a single large display using Rocks Cluster and Viz Roll. We have now begun using the large display wall, and expect that the advantages offered by the use of the large, high-resolution display will be beneficial for further developments.

You'll see our display wall at SPring-8 technical tour!