Abstract

The two BXC core facility beamlines at SRRC, demanded by the National Research Program for Genomic Medicine, will be designed to support high-throughput structure determinations. Tasks that require high power CPUs and heavy traffic of data flow are expected. On the other hand, the computing and network environment should be simple, stable and robust.

The terminologies and technologies we used in the design will be explained, and different technologies will be compared, so that we can choose a better one for our design.

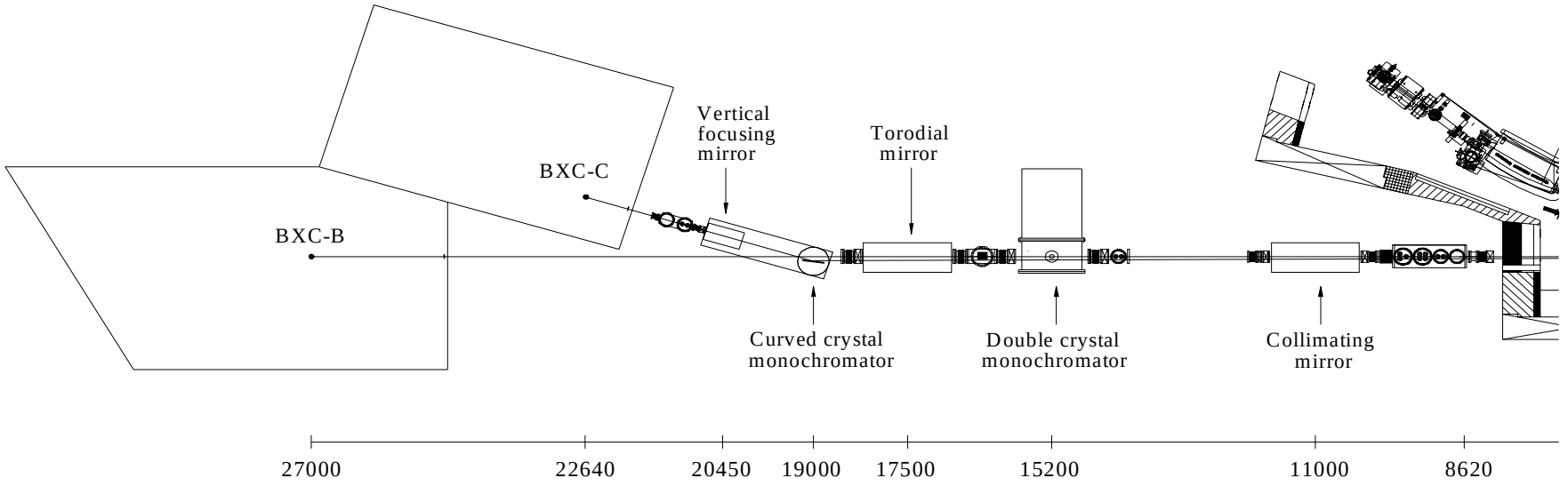
Keywords: SAN, NAS, CXFS[2], NFS, SCSI, TCP/IP, Gigabit Ethernet, and Fibre Channel.

[1] http://www.sgi.com/products/storage/software.html

The SRPX Beamlines

Beamline Specification

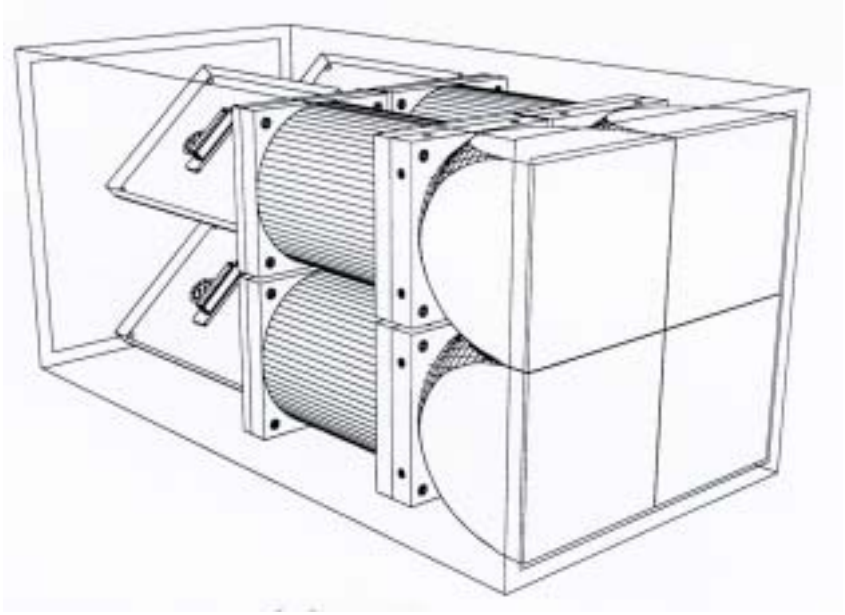
Feature / Beamline	Horizontal Acceptance Angle H X V (mrad)	Monochromator	Energy(keV)	Focused Beam Size FWHM H X V (mm)	Resolution △E/E	Flux(100um pinhole) Photons / 200mA
Side (BXC-C)	1 X 0.4	Curved Si(111)	13	~0.6 X 0.1	$1.5X10^{-3}$	$\sim 8X10^{10}$
Center (BXC-B)	1.75 X 0.2	Plane DCM Si(111)	6.5~19	~0.25 X 0.17	$2.5X10^{4}$	$\sim 1X10^{11}$

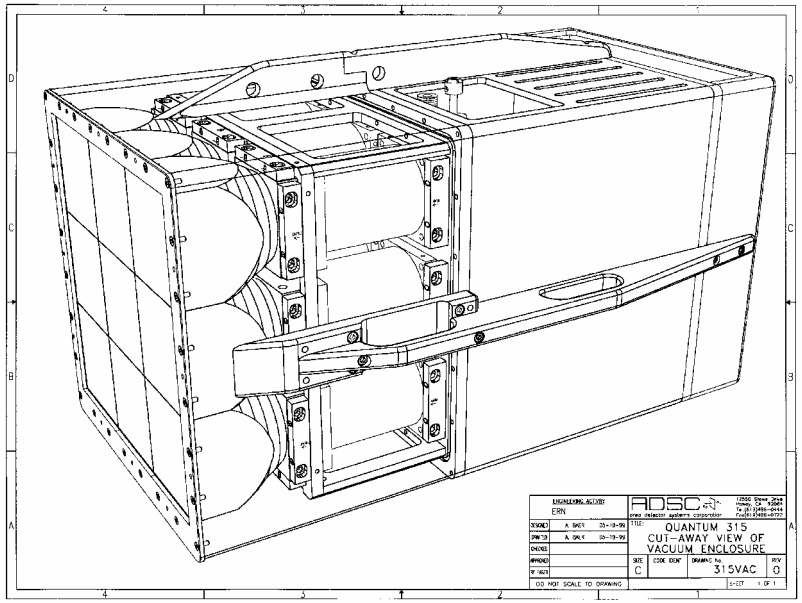


Beamline Performance

- **Focal beam intensity through a 0.2 mm pinhole : 3.5×10^{11} ph/sec in Si(111) bandwidth at 12.65 keV**
  - About 35 times higher than *SRRC* wiggler beamline *17B2* (**1.0×10^{10}** ph/sec, 0.2mm pinhole, 11 keV)
  - About 17 times higher than *SPring-8* bending beamline *12B2* (**2.0×10^{10}** ph/sec, 0.2mm pinhole, 12 keV)
  - About the same as *SSRL* wiggler beamline *9-2* (**4×10^{11}** ph/sec, 0.2mm pinhole, 12 keV)
  - About the same as *NSLS* wiggler beamline *X25* (**4×10^{11}** ph/sec, 0.2mm pinhole, 12 keV)
  - About the same as *ALS* wiggler beamline *5.0.2* (**8×10^{10}** ph/sec, 0.1mm pinhole, 12 keV)

Detectors





ADSC Quantum 210

4 CCD chips

ADSC Quantum 315

9 CCD chips

Data Generation Rate

Detector: ADSC Quantum 210

File Size: 36MB

Readout Time: <2 seconds

Expected Exposure Time: 10 seconds

Data Generated per seconds: 3.6MB

Data Generated per 8 hours: 101 GB

Detector: ADSC Quantum 315

File Size: 72MB

Readout Time: <2 seconds

Expected Exposure Time: 10 seconds

Data Generated per seconds: 7.2MB

Data Generated per 8 hours: 202 GB

Total Bandwidth Required: 3.6 + 7.2 = 10.8 MB/s = 86.4 Mb/s

Bandwidth of Fast Ethernet: 100 Mb/s * 0.6 = 60 Mb/s

Applicable Technologies: Gigabit Ethernet or Fibre Channel

Network Architectures

	Fibre Channel	Gigabit Ethernet
Technology application	Storage, network, video, clusters	Network
Topologies	Point-to-point loop hub, switched	Point-to-point hub, switched
Baud rate	1.06 Gbps	1.25 Gbps
Scalability to higher data rates	1.12 Gbps, 4.24 Gbps	Not defined
Guaranteed delivery	Yes	No
Congestion data loss	None	Yes
Frame size	Variable, 0-2KB	Variable, 0-1.5KB
Flow control	Credit Based	Rate Based
Physical media	Copper and Fiber	Copper and Fiber
Protocols supported	Network, SCSI, Video	Network

http://www.fibrechannel.com/technology/overview.html

The Protocols

SCSI

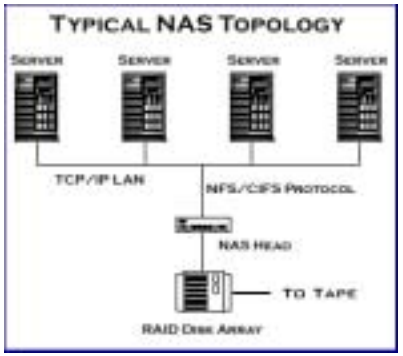
- Mature and well established protocol used for fast access to storage devices.
- File transfer method: block I/O.
- Applications: connecting computers to peripheral devices such as hard disk drives and other devices that needs to transfer large amounts of data quickly.

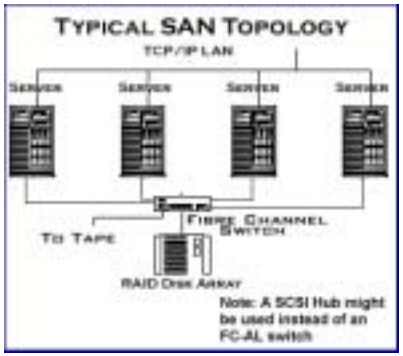
TCP/IP

- Mature and well established protocol used for communication between (different flavors of) computers.
- File transfer method: file I/O.
- Applications: to create a Network of Networks (the “Internet”) in which all types of systems from al vendors can communicate.

Storage Architectures

NAS	SAN
File oriented	SCSI-block oriented
Ethernet-based	Fibre channel-based
Usually provided specifically for general client access	Storage is isolated and protected from general client access
Supports client applications with lower performing NFS/CIFS	Supports server applications with high performance Fibre Channel
Can be installed quickly and easily	Install can be complex





NAS: Network Addressable Storage

SAN: Storage Area Network

Conclusion

Large amount of data flow on the net	→	Gigabit Ethernet or Fibre Channel
Application: storage	→	*SCSI protocol*
		↓
SAN Architecture	←	*Fibre Channel*
Filesystem we choose	→	*CXFS filesystem*

File System

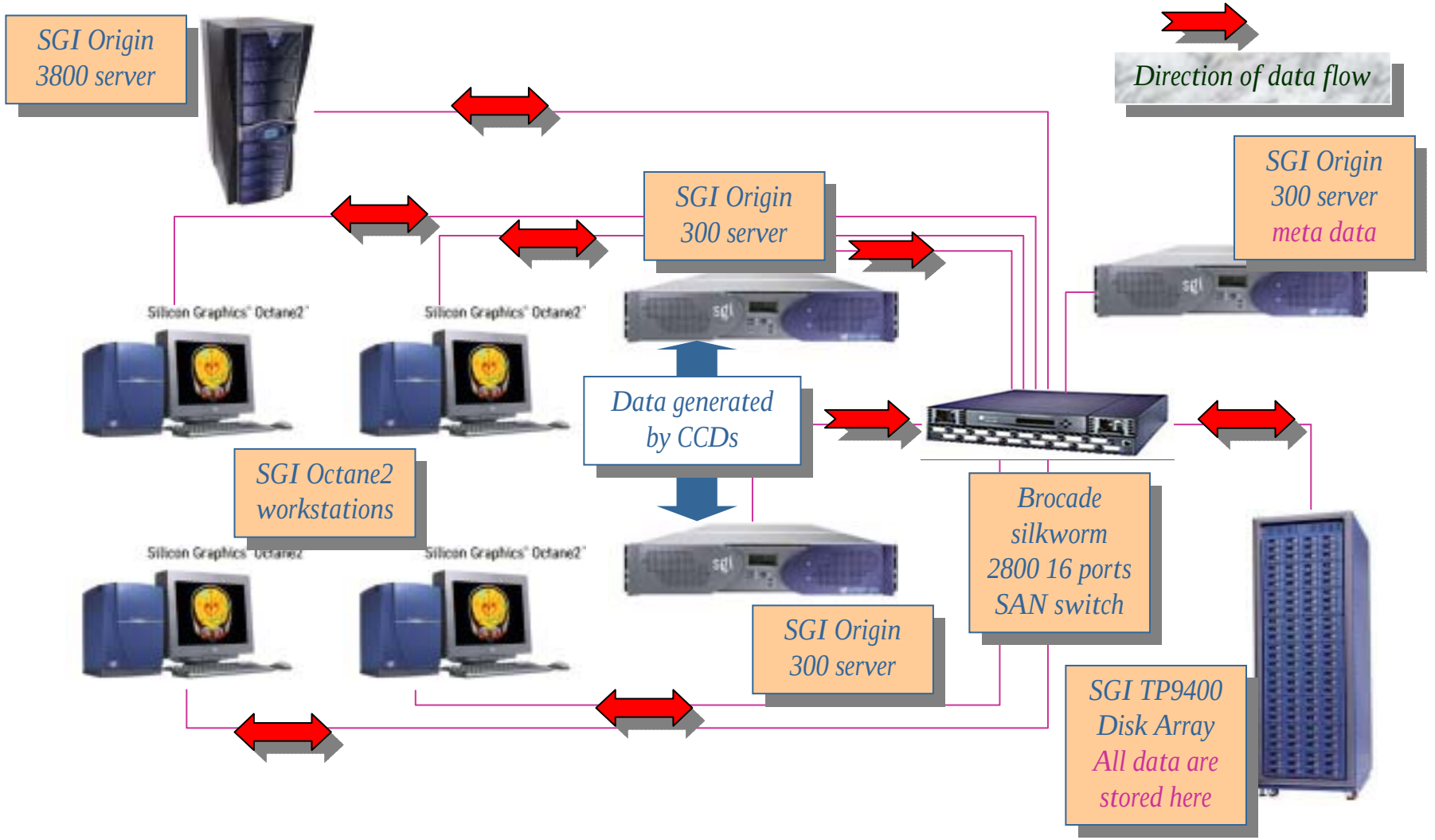
CXFS: a clustered SAN Filesystem from SGI

- *CXFS is a shared filesystem: our task in maintaining the filesystem is simplified*
- *CXFS has great resilience: no single points of failure*
  - *All hosts in the cluster are backup servers*
- *CXFS is based on the high-performance and highly reliable XFS file system*

The reason we choose SGI computers:

- *System Efficiency, including data transfer bandwidth, data transfer protocol, scalability of file system, and volume and file system manager performance.*
- *Almost all local users use SGI computers in their home labs.*
- *SRRC BL17B2 station uses SGI computers completely.*
- *Spring-8 BL12B2 station uses SGI computers completely.*
- *The key software – HKL/HKL2000 supports SGI and Linux only. But the performance of the Linux version is not good.*

The Infrastructure



Computers and Hardware

Hardware	Qty	Description
SGI Origin 3800	1	Responsible for all computational tasks, including data processing, phasing, and model building.
SGI Origin 300	1	Responsible for beamline hardware control, and handles the image files generated by the ADSC Quantum 315 CCD detector.
SGI Origin 300	1	Responsible for beamline hardware control, and handles the image files generated by the ADSC Quantum 210 CCD detector.
SGI Origin 300	1	Running the SGI CXFS Meta Data Server and NIS Server, this computer is responsible for the file sharing and integration for all computers.
Cisco Catalyst 6509 Router	1	Responsible for the communication between the computers.
SGI Octane2 PowerDuo	6	Beamline users use these computers to perform their experiments.
Brocade Silkworm 2800 SAN Switch	1	A SAN switch, which is very important for SAN architecture.
SGI TP9400 Disk Array	1	The total capacity is 2.11 TB.