

**BACKUP PLANNING AND IMPLEMENTATION**  
**FOR ANUPAM SUPERCOMPUTER**  
**USING ROBOTIC AUTOLOADERS**

BY

**Aalap Tripathy      2004P3PS208      B.E. (Hons) Electrical & Electronics**

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**Supercomputing Research Facility, Computer Division**

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**Aalap Tripathy**  
**[aalap@bits-goa.ac.in](mailto:aalap@bits-goa.ac.in)**



**BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE  
PILANI (RAJASTHAN)  
Practice School Division**

Station : Computer Division, BARC

Centre : Mumbai, Maharashtra

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SUPERCOMPUTER USING ROBOTIC AUTOLOADERS

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Prepared By :

ID Number	Name	Discipline
2004P3PS208	Aalap Tripathy	B.E. Hons. Electrical & Electronics

Experts Involved :

Name	Designation	Division
<u>Mr K Rajesh</u>	Scientific Officer (F)	Supercomputing Research Facility, Computer Division
Mr Kislay Bhatt	Scientific Officer (E)	Supercomputing Research Facility, Computer Division
Mr Phool Chand	Scientific Officer (E)	Supercomputing Research Facility, Computer Division

Name of the PS Faculty : Dr. Himanshu Agarwal,  
Asst. Professor, Mechanical Engineering Group

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Project Areas : Backup Automation for user data to the tune of 3.2 Terabytes. Customized scripts to simplify administration of the Autoloader by robotics control commands

Abstract : This project aims to automate backup from 12 file servers to tapes mounted on Tandberg Tape autoloader - LTO Ultrium ( Ultrium 2 ) by the use of shell scripts. A complete package including web interface has been developed and customized for use for ANUPAM supercomputer at BARC – BMS (Backup Management Suite)

Signature of Student  
Date

Signature of PS Faculty  
Date

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**Appendix B : Technical data - Tandberg SuperLoader LTO2**

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**Appendix F : Code View of the scripts written**

**Appendix G : Code View of the PHP Scripts & HTML Pages**

# 1. Introduction

## 1.1 Objective

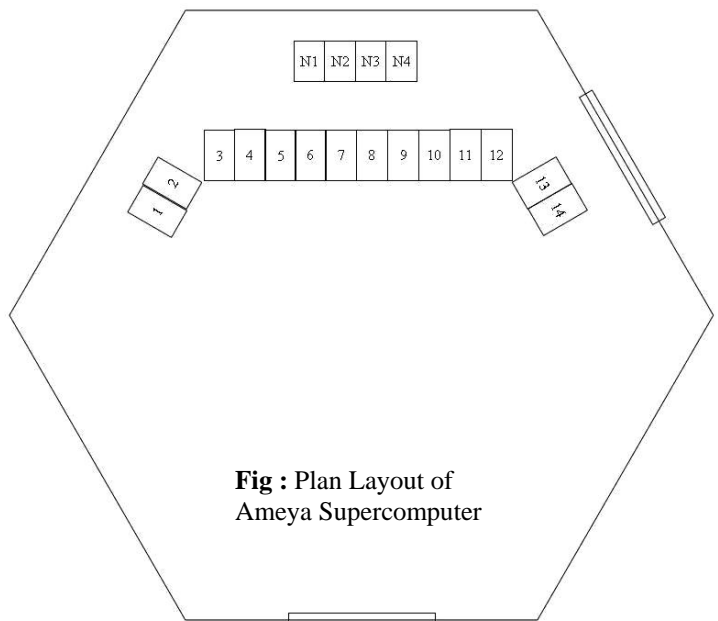
The major driving force behind this work was to **automate** the back up procedure for the file servers (sagar01-sagar12) from a full backup taken on the 1<sup>st</sup>, 8<sup>th</sup>, 15<sup>th</sup>, 23<sup>rd</sup> days of a month to a combination of full and incremental types. Failsafe procedures were to be developed with appropriate checks for extraordinary circumstances like power failure / hardware error. Logging was to be improved. Index files of the files being created were generated which were searchable. The aim is to provide a complete **backup management suite** similar to what major commercial/open source packages provide. Some additional features like holding disks etc were also to be implemented.

## 1.2 System Analysis and Definition

ANUPAM is a series of **parallel computers** developed at Computer Division, BARC to cater to the need of **high computing power** for various high performance applications. This system is used by BARC scientists in a wide range of fields like Reactor Physics, Reactor Engineering, Crystallography, Molecular Dynamics and Computational Fluid Dynamics etc.

The cluster is spread across 14 racks.

- o 10 racks (Racks 1-5, 10-14) house the compute nodes
- o 2 racks (racks 6,9) house the storage and backup servers
- o 2 racks (racks 7,8) house the service nodes and networking equipment.
- o Racks numbered N1 to N4 are campus networking racks



**Fig :** Plan Layout of Ameya Supercomputer



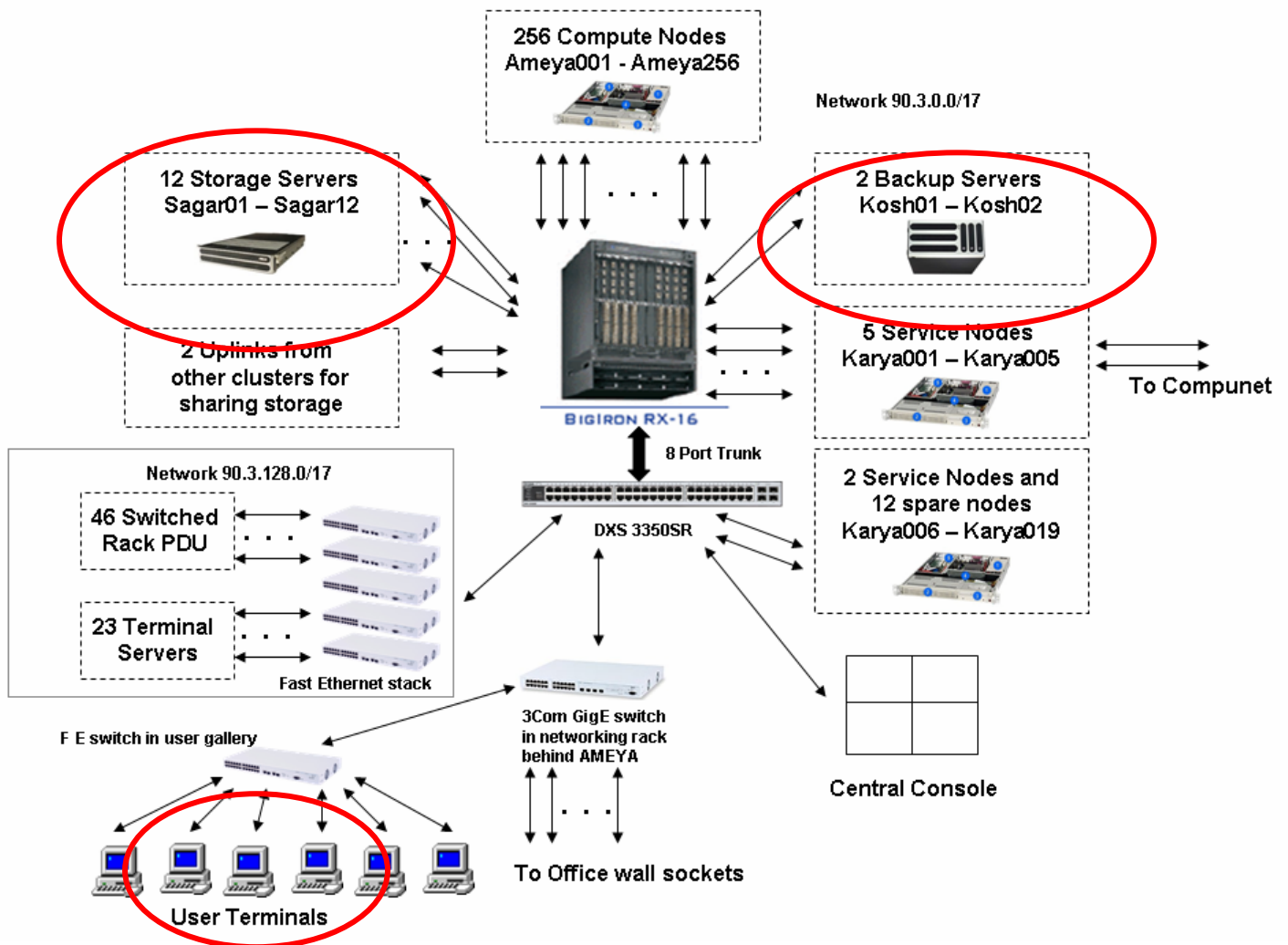
**Fig :** Perspective View of Ameya Supercomputer



Fig : Perspective View of Aruna Cluster

Fig : Perspective View of Ashva Cluster

### 1.2.1 System/Network Diagram of AMEYA



All of the user's files are stored onto partitions located on any one of the 12 Storage Servers. These are accessible from the backup servers (kosh01 & kosh02) which are themselves interfaced to tape backup devices which in turn perform the backup operation as explained further. All of the development and control is done from the User Terminals shown above.

## 1.2.2 Submission of jobs

A job is typically a shell script, FORTRAN programme, C language program etc with a set of attributes which provide resource and control information about the job.

A batch means that the job will be scheduled for execution at a time chosen by the subsystem (defined below) according to a defined policy and the availability of resources.

Portable Batch System (PBS) is a networked subsystem for submitting, monitoring and controlling a workload of batch jobs on one or more systems.

In PBS, a queue is just a collection point for jobs and does not imply execution ordering. This is done by a scheduling policy decided by the system administrator.

The above details are only for academic interest and are not required for an understanding of the backup mechanism described later.

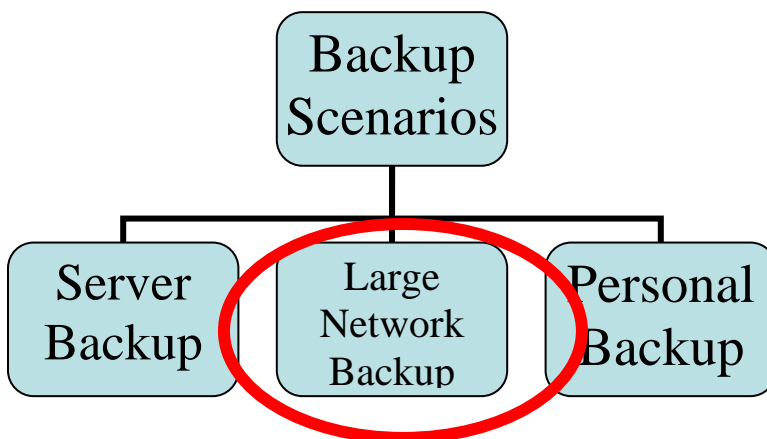
## 1.3 Analysis of Organizational Data

For the execution of a job, users of ANUPAM have to submit valid program(s) with associated data set onto their user space. The results of their computation are also stored onto it. There is no restriction on the number/size of jobs which can be submitted to the system. System Administrators are also flexible with respect to the amount of space allocated to a user – i.e. it is often changed on request. **However the size of filesystems is fixed and their entire content is to be backed up to the tape drives.**

User Data for Anupam (Ashva and Ameya) consists of programs, scripts applications. These are present on the Fileservers which are mounted by an auto mount script by the Network File System onto **mount points** accessible as /home/usr010 , /home/usr011, /home/usr020, /home/usr021, /home/usr030, /home/usr040, /home/usr050, /home/usr060, /home/usr070, /home/usr080, /home/usr090 , /home/usr110 , /home/usr120 Besides there are other partitions which are not backed up. They are in single digits viz /home/usr7. Each of the above mentioned partitions contain home directories of various users. **Each one of the above mentioned partitions are of size 200 GB each.**

A study of each partition as detailed in Appendix C shown showed that in most cases the entire space is not being used currently.

## 1.4 Choosing the right backup type – requirements v/s issues involved



The system at ANUPAM corresponds to a **Large Network** Type where the file systems are connected by Fast Ethernet Switches ( 1 Gbps) to each other and the controller.

- When to backup
  - It is a **resource hungry process**
  - It **stresses** both the **systems and the network**
  - Full backup takes **4 hours** on an average
  - It should therefore be **done** when the system is not in **active use**
  - **Full Backup** is may be done **on weekends** where the **backup window** is 24-36 hours
  - **Incremental Backup** to be done on weekends after Office hours with a backup window of 3-12 hours
- Volume Configuration
  - The data on each file server is in terabytes, so high efficiency is to be achieved by efficiently transferring only essential data minimum number of times.
  - The life of the tapes is also an issue. Supplied tapes have a proclaimed efficiency of 2000 rewrite cycles.
- Backup Policy
  - The backup policy to be such that, system administrators can assure users that their files will be safe upto the maximum possible extent.
  - Also it should be able to restore a version of a file that the user requests say the version on <date>.
  - All possible user files should be backed up onto tapes with minimum effort.

## 1.5 Possibility of growth

There are currently 12 file servers. Each of them have averaged 6 - 200 GB hard disks. This computes to  $1200 \times 12 = 14400$  GB approx 14 Terrabytes. Further, there is a proposal to increase the current configuration from 256 nodes ( $256 \times 2 = 512$  CPUs) to an aggregate 1000 CPUs. There is also a proposal to migrate to higher capacity tape drives with autoloader capacity. The current system is to be built to survive this expansion successfully. Also Autoloader's with 100 tapes is proposed to be bought. The backup scripts should be able to run on the advanced autoloaders easily.

## 1.6 Tape Loader Interfacing

The Tandberg Autoloader was equipped with 16 removable tapes each having a recording capacity of 200 GB. This adds up to available storing capacity of 3200 GB i.e. 3.2 TB

This Autoloader was interfaced to a server running "Scientific Linux". **This server was kosh02.**