

elements (up to third-order), beta functions, tunes, chromaticities, radiation integrals, natural emittance, floor coordinates, beam moments, etc.. It also has the ability to optimize results of tracking using a user-supplied function of the beam parameters at one or more locations.

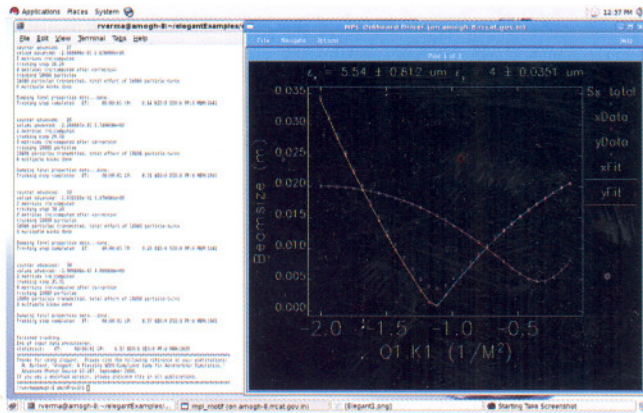


Figure I.1.2: Beam analysis using Elegant and its GUI

Sequential application **Tracy3** is successfully ported on Intel Xeon Linux server. This program does the computation of off momentum particle (i.e. electrons) loss in presence of multipolar magnetic field error.

Parallel application **ORBIT_MPI** (Objective Ring Beam Injection and Tracking - a particle tracking code for particle accelerator rings) is successfully ported on Kshitij-1 HPC cluster using GNU FORTRAN 77 & C (g77, gcc) compiler, OpenMPI version 1.3.3, FFTW version 2.1.5.

Porting of above three software packages i.e. Elegant, Tracy3 and ORBIT_MPI was required by Indus Operations & Accelerator Physics Design Division.

Parallel application **ADF** bundle with HPMPI (Amsterdam Density Functional, version 2010 - a FORTRAN program for calculations on atoms and molecules) has been ported successfully on Kshitij-2 HPC cluster. Porting of this software was required by SRS Coordination section.

E) Training and hands-on sessions conducted at User Hall:

One week training course on **Microsoft Excel** was organized by Computer Centre for RRCAT employees in two batches during 18th July to 29th July 2011.

One week training course on **HTML 5** was organized by Computer Centre from 10th October to 14th October 2011.

*Reported by:
Alpana Rajan (alpana@rrcat.gov.in) and Anil Rawat*

I.2: Development of Information Systems at RRCAT

A) Commissioning of new RRCATInfonet server in load balancing mode for high availability of applications:

The reliability and availability of RRCATInfonet server has become critical due to deployment and wide usage of applications like Project Monitoring Software, Budget Monitoring Software, Indent Preparation Module, Purchase Information Module, software packages for APAR (Annual Performance Assessment Report) Evaluation and Assessment, Leave, Payslip & Income Tax details etc.. These application software packages have wide user base, thus they have direct performance value and time window limit associated for any downtime and unavailability.

Server Load Balancer SLB was installed and configured for Tomcat web server with features for application acceleration, failover, security and management for new RRCATInfonet clustered servers.

The new setup of Server Load Balancer and clustered web server has been configured to provide high performance, high availability, and scalability of RRCATInfonet applications by distributing the load among application servers. Load balancing switch has been configured to route the http, https, sftp and smtp requests to distribute load among application servers by maintaining IP persistency in round-robin manner. Two Application servers have been setup by using Apache Tomcat v 6.0.29 and JRE v 1.5. One server has been configured as file server to share the application directory to the web servers over NFS (Network File System version 4.0).

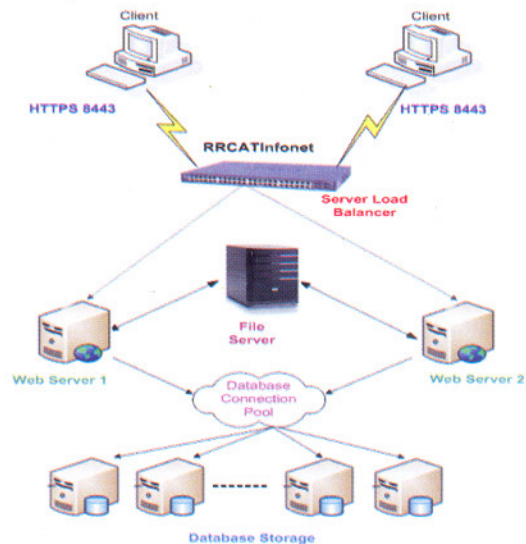


Figure I.2.1: Server Load Balancer for applications on RRCATInfonet



The application servers and file server have been installed and configured on Dual processor Quad core Xeon @3.4 GHz servers with 16 GB RAM. SSL is configured for digital certificate based applications. Configuration has been done for integration of Tomcat Web Server and Java Servlets with Oracle 10g OCA (Oracle Certifying Authority) server for PKI (Public Key Infrastructure).

Server load balancing will help to address the following requirements:

High Scalability - Server load balancing makes the two servers appear as a single server - a single virtual service - by transparently distributing user requests among the servers. Thus making the setup highly scalable.

- High Performance - Server load balancing can direct user requests to the server which is least busy and therefore capable of providing fast response time.
- High Availability - It improves application availability because if an application or server fails, load balancing can automatically redistribute user requests to the other server.

This new setup of RRCATInfonet in load balanced mode will provide better performance and response to the users.

B) Development and deployment of software for On-line Submission of Applications for Recruitment of RRCAT on Internet:

Web based software has been designed, developed and deployed for on-line submission of applications on Internet for Recruitment of RRCAT. The software is developed using open source tools like PHP version 4 and MySQL version 5. Application software has been deployed on Linux server with CentOS (64 bit) version 5.5, MySQL database with open source GreenSQL firewall to protect the database from various known threats.

Post Code	Post	Qualification	Desired Experience	No. of Posts	Click here to Apply
I	Scientific Officer-C (Computer)	M.E./M.Tech in Computer Science/Computer Engineering with a minimum of 60% marks or equivalent CGPA after Experience of Software development in Java, JSP, J2EE, B.Tech. (with 60% marks or equivalent CGPA) in Surveys etc. Knowledge of ORACLE RDBMS Computer Science/Computer Engineering	Desirable Experience 2 years in planning & execution of building air conditioning works Job Description: Planning, design and execution of works pertaining to HVAC and other mechanical utilities	1 (Reserved for OBC)	<input type="button" value="Apply"/>
II	Technical Officer-C (Mechanical)	B.E. in Mechanical with a minimum of 60% marks or equivalent CGPA	Desirable Experience 2 years in planning & execution of building air conditioning works Job Description: Planning, design and execution of works pertaining to HVAC and other mechanical utilities	1 (Reserved for OBC)	<input type="button" value="Apply"/>
III	Scientific Assistant-B (Civil)	Diploma in Civil (3 Years after SSC) with a minimum of 60% marks	Desirable Experience 2 years in civil construction works Job Description: Supervision, estimation and costing for civil works	03 Posts 3 - Computer 1 - Civil 1 - Refrigeration & Air Conditioning 1 - Horticulture (5-0% reserved for OBC)	<input type="button" value="Apply"/>
IV	Scientific Assistant-B (Refrigeration and air conditioning)	Diploma in Refrigeration & Air conditioning (3 Years after SSC) with a minimum of 60% marks	Desirable Experience 2 years in erection and Commissioning of HVAC works Job Description: Erection, Commissioning and maintenance of HVAC works	03 Posts 3 - Computer 1 - Civil 1 - Refrigeration & Air Conditioning 1 - Horticulture (5-0% reserved for OBC)	<input type="button" value="Apply"/>

Figure I.2.2: On-line Application Submission for RRCAT Recruitment

The software has two steps for Registration process for candidates applying on-line. Based on the information filled by applicants in first step, login credentials are sent to them through email.

You are applying for the following Post against Advertisement No: **RRCAT-2011**

Post Code	Post	Qualification	Pay Scale (Rs.)	Total including all allowances (Approx. in Rs.)
I	Scientific Officer-C (Computer)	M.E./M.Tech in Computer Science/Computer Engineering with a minimum of 60% marks or equivalent CGPA after B.E./B.Tech. (with 60% marks or equivalent CGPA) in Computer Science/Computer Engineering	Pay in the Pay Band 15,600/- Grade Pay 5400	40000/-

If you have already registered for this Post [Click Here](#)

For new User registration, fill up the following details

Advertisement No: RRCAT-2011
 Post Code: I
 Name: Ramesh Patidar
 Gender: Male Female
 Email Address: suresh@gmail.com
 Security Pin:

Figure I.2.3: User Registration Form

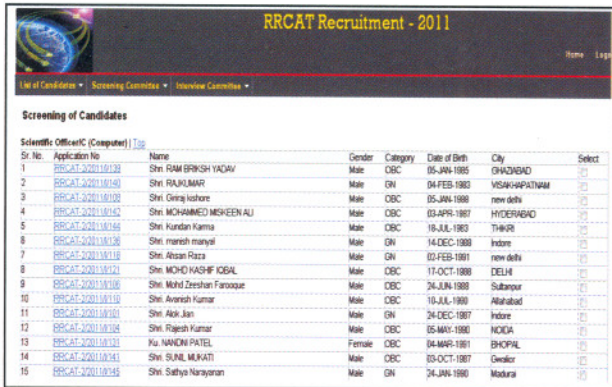
After entering his/her credentials (Email-id and password), applicant will be required to fill Personal Details, Educational and Professional Qualifications, Course of Study, Experience, Details of Relatives employed in DAE etc. Applicant can edit the application details and preview the application form before final submission of application. After completion of final submission, the application form is generated in PDF format and applicant can not modify application details. Applicant can print the application form and send the signed paper copy with required certificates to Recruitment Section for further processing.

After final submission of application form, an email is sent to the applicant mentioning his Application Number for future reference and correspondence.

Application forms have been developed using PHP, HTML and Javascript. Appropriate validations are enforced for mandatory fields. The software was tested thoroughly before deployment using SQL injection tests.

Data Pump procedure is written in Java for data consolidation with Oracle 10g and MySQL databases. Data is synchronized between Internet database server (MySQL) and internal database server (Oracle 10g). Software module for Recruitment Section has been enhanced for maintaining information related to applications for RRCAT Recruitment. The software provides interface for entry from paper based applications received by Recruitment (i.e applications not filled online over Internet by the applicants). Provision has been made for updation of "Paper copy received" status of application submitted online from Internet and its paper copy received at Recruitment. Call letters for applicants were generated by using this software.

Administrative interface was developed and deployed on RRCATInfonet for viewing Post-wise applications submitted from Internet or entered by Recruitment Section. The software was used for screening of applications on the basis of eligibility criteria like Diploma/ Graduate/ Post Graduate Percentage/ marks, age, category etc. Information related to screened-in applicants was generated for screening committees. Using this software PDF file of selected applicants can be generated for RRCAT website.



Sr. No.	Application No.	Name	Gender	Category	Date of Birth	City	Select
1	RRCAT_200110139	Shri RAM ERIKSH YADAV	Male	OBC	05-JAN-1985	GHAZIABAD	<input type="checkbox"/>
2	RRCAT_200110140	Shri RAJKUMAR	Male	GN	04-FEB-1983	VISAKHAPATNAM	<input type="checkbox"/>
3	RRCAT_200110108	Shri Girraj Mishra	Male	OBC	05-JAN-1980	new delhi	<input type="checkbox"/>
4	RRCAT_200110142	Shri MOHAMMED MSKREEN ALI	Male	OBC	03-APR-1987	HYDERABAD	<input type="checkbox"/>
5	RRCAT_200110144	Shri Kundan Kumar	Male	OBC	16-JUL-1983	THIRUR	<input type="checkbox"/>
8	RRCAT_200110138	Shri. manish mayal	Male	GN	14-DEC-1989	Indore	<input type="checkbox"/>
9	RRCAT_200110138	Shri. Anjan Raza	Male	GN	03-FEB-1991	new delhi	<input type="checkbox"/>
8	RRCAT_200110171	Shri. MOH YAKHIF IQBAL	Male	OBC	17-OCT-1989	DELHI	<input type="checkbox"/>
9	RRCAT_200110106	Shri. Mohd Zenshan Farooque	Male	OBC	24-JUN-1989	Subansari	<input type="checkbox"/>
10	RRCAT_200110110	Shri. Avesh Kumar	Male	OBC	10-JUL-1980	Aligarh	<input type="checkbox"/>
11	RRCAT_200110101	Shri. Akh. Jan	Male	GN	24-DEC-1987	Indore	<input type="checkbox"/>
12	RRCAT_200110104	Shri. Rajesh Kumar	Male	OBC	05-MAY-1990	INDIA	<input type="checkbox"/>
13	RRCAT_200110101	Ku. NANDINI PATEL	Female	OBC	04-MAR-1991	BHOPAL	<input type="checkbox"/>
14	RRCAT_200110141	Shri. SUNIL MUKATI	Male	OBC	03-OCT-1987	Gwalior	<input type="checkbox"/>
15	RRCAT_200110145	Shri. Sathy Narayanan	Male	GN	24-JAN-1980	Madurai	<input type="checkbox"/>

Figure I.2.4: Administrative Interface on RRCATInfonet for RRCAT Recruitment

Provision has also been made in the software for viewing the status of application (on Internet) on the basis of applicant's email-id, application no. and date of birth.

This software was used successfully for submission of applications on-line over Internet and further processing. The software reduced manual data entry of applications by Recruitment Section.

C) Performance Analysis of Web based Applications on Single and Multi Core Servers:

Performance of existing single core single processor RRCATInfonet server was compared with dual processor quad core server for response time of web server, throughput (number of hits v/s response time) and connection pooling v/s no connection pooling using Open Source Performance Testing Tool Apache JMeter. It was found that performance of Java applications running on multi-core server is far better than those running on single core server. Web applications running on multi-core server give better performance and scalability.

Apache JMeter was used to load test the functional behaviour and measure performance based on throughput (number of hits v/s response time) for dynamic querying of Purchase database using Java servlets on Tomcat Web Server. The performance was tested by varying the number of users

and number of threads. Load of 1000 users was simulated on the database server to analyze overall performance under different load conditions. The results are shown graphically in following two figures.



Figure I.2.5: Throughput on Single Core Server



Figure I.2.6: Throughput on Quad Core Server

Based on the analysis of performance of web server, the throughput of 1000 concurrent requests on quad core server was 180 per minute as compared to 69 per minute on single core. This shows that throughput of dual processor quad core server is almost three times more than that of single core server for 1000 concurrent users. Applications running on quad core server give more throughput and less response time as compared to single core server.

Performance was also compared by running the tests using Java Servlets for connection pooling and also by acquiring connections directly from the JDBC driver without connection pooling. On comparing the pooling results at each iteration checkpoint with the non-pooling results, it was found that connection pooling provides a significant improvement on performance by reusing connections rather than creating a new connection for each connection request.

Based on the JMeter results shown graphically in Figure I.2.7 and I.2.8, it was observed that the throughput of 1000 concurrent requests using pooled connections was 468 per minute as compared to 83 per minute using non pooled connections.



This indicated that throughput using pooled connections is almost six times faster than non pooled connections and web applications realize significant performance improvements by using connection pooling over no connection pooling.

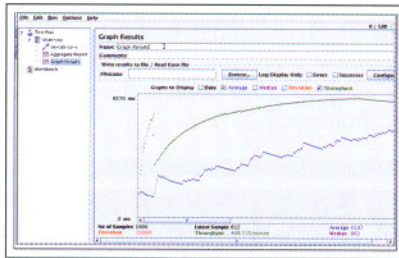


Figure I.2.7: Pooled connections throughput



Figure I.2.8: Non pooled connections throughput

D) Oracle Certifying Authority 10g setup for Digital Certificate based Applications:

Infrastructure for Oracle 10g OCA (Oracle Certifying Authority) has been setup for issuing and managing Digital Certificates. This PKI (Public Key Infrastructure) setup will be used for management of Digital Certificates that provide digital identities required to automate Digital Signature based processes.

Oracle 10g platform provides tightly integrated Oracle Certifying Authority (OCA) and Oracle Single Sign-on. The integration of Single Sign-On with OCA enables less time consuming setup for SSL communication between client, application server and database server. Oracle PKI setup needs combination of robust infrastructure for managing and distributing digital certificates and also for enforcing policies related to certificate strength and validity period.

We have configured OCA end-user interface to obtain a certificate which can be imported into user's internet browser using Single Sign-on credentials. We have imposed 1024 bits RSA key length for employees and 2048 bits RSA key length for servers/ PCs. The certificate validity period can also be defined. Unique certificate constraint has also been enabled to prevent OCA from issuing multiple certificates to the same employee.

Using this OCA PKI setup, Digital Certificates have been tested as proof-of-concept for:

- Reliable two factor user authentication - the first factor is proof of possession of private key and second factor is validation of public key belonging to specific identity by OCA.
- SSL communication for web server - client browser validates identity of a web server and encrypts data flow between browser and web server.

OCA PKI setup will be used for deployment of workflow based applications in near future.

Reported by: Alpana Rajan (alpana@rrcat.gov.in) and Anil Rawat

I.3: Development in Networking and Communication at RRCAT

A) Email service enhancements:

In our endeavor to improve and secure the emails services at RRCAT, following enhancements were made to the email services setup:

1) Enhancements to LDAP (Lightweight Directory Access Protocol) setup:

Email accounts at RRCAT are being managed using LDAP based directory service with "ou=People,o=cat,c=in" as the base Distinguished Name (DN). This setup was upgraded by adding "Account Validity", "Account Status", "Description" and "Internet Access" attributes to each account record. Proper values of these attributes for every account (1800) were verified and then inserted in the existing database using PHP and shell scripts. Figure I.3.1 depicts email account details view showing newly added attributes.

Entry Attributes	
accountStatus	active
accountValidTill	20281130085528Z
ccNo	1125
cn	Smt. Swati Chaudhari
deliveryMode	notical
deliveryProgramPath	prtmr.prcmail-in-1.ecp@protonic
description	employee
displayName	Smt. Swati Chaudhari
gecos	Smt. Swati Chaudhari
gidNumber	500
homeDirectory	/home/suprasri
internetAccess	yes

Figure I.3.1: Email account details view