I.1 Commissioning of High Performance Computing Cluster, Kshitij-4 (क्षितिज-4)

High Performance Computing Cluster (HPCC), Kshitij-4 (क्षितिज-4) is commissioned in RRCAT for Scientific and Engineering applications. This HPCC is equipped with 64 HP Blade servers housed in four Blade enclosures, two HP rack mounted servers, and 56 Gbps Mellanox InfiniBand (IB) switches. Total 1536 computing cores, 12 TB aggregate memory and a SAN system for user data storage of 84 TB are also available in Kshitij-4 for advance computations.

Fig. I.1.1: HPC Cluster Kshitij-4

This HPCC has been configured by using Open-source software to function in fail-safe mode. Open LDAP has been configured in dual master mode and Resource Manager - TORQUE and Scheduler - MAUI are also implemented in high-availability mode. If any problem occurs in master node, cluster will work uninterruptedly with redundant master node.

High I/O capability is one of the main features of this HPCC, which has been implemented through Lustre Parallel File System. Lustre is configured as file system of Kshitij-4 cluster with FDR InfiniBand Network. Metadata Server (MDS), Four Object Storage Target (OST), Lustre Network (LNET) and Lustre management server are also installed and configured for implementation of this file system.

Inter Process Communication Libraries - MPICH (mpich-3.1.3), MVAPICH2 (mvapich2-2.0.1), OPENMPI (openmpi-1.8.4) are configured for supporting various types of parallel applications. Intel FORTRAN & C compilers version 14 and Math Kernel Library are configured on this cluster for parallel computations.

Web based scalable distributed monitoring system 'Ganglia' version 3.1.7 has been configured with 'rrdtool' version 1.3.8 on Kshitij-4 and deployed on RRCAT Net. Consolidated cluster usage in terms of Load, CPU, Memory, Network and detailed usage of each node in terms of Load, CPU, Memory, Network, Disk, Packets in/out etc. are available through this monitoring tool. All these details are available for last one hour to one year in graphical form.

Unified Fabric Manager (UFM) tool has been installed and configured for management and monitoring of InfiniBand network of Kshitij-4 consisting of 66 servers, four numbers of 18 ports IB chassis switches and one centralized 108 ports IB switch. User Interface (UI) of UFM is also implemented for smooth operation of InfiniBand network.

Benchmarking of Kshitij-4:

Benchmarking of HPC Cluster, Kshitij-4 was carried out using standard open source Intel MP_ LINPACK and Inter Process Communication Libraries - MVAPICH2. Benchmarking tests were carried out with 10,000 as initial size (N) of system of equations and we achieved peak performance of Kshitij-4 cluster at N=12,29,500. This cluster delivered Peak Computing Power of 29.88 Teraflops.

Kshitij-4 among top 30 Super Computers in India:

Indian Institute of Science (IISc), Bangaluru publishes list of top thirty Super Computers in India on their website. The list is published twice every year (June and December). Kshitij-4 High Performance Computing Cluster (HPCC) is listed at no. 21 in the list published in June 2015. The cluster has delivered 29.88 Teraflops peak computing power and has theoretical computing power of 33.17 Teraflops. The cluster has been fine tuned, achieving more than 90% of theoretical computing power, which is as per the international standards.

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