

**Earth System Science Organization
Ministry of Earth Sciences
Government of India**

Brief about New HPC Facility

Introduction:

One of the primary goals of Earth System Science Organization (ESSO) of Ministry of Earth Sciences (MoES) is to develop and improve capability to forecast weather, climate and hazard related phenomena for societal, economic and environmental benefits. To achieve this objective, the ESSO has been providing weather/ climate related services on land and ocean through its various constituent units by focusing on understanding of earth system processes, modeling and forecasting, and capacity building. The use of medium-resolution dynamical numerical models along with appropriate assimilation of data from different platforms including satellites is one of major reasons in the recent improvements in weather and climate forecast (e.g. Phailin Cyclone Forecast, Uttarakhand Heavy rainfall event, and long range prediction of seasonal mean monsoon rainfall). To produce the forecasts using these models requires data assimilation and integration of the models. High Performance Computers (HPC) is a crucial requirement for running dynamical weather and climate models. For this purpose ESSO- MoES had setup HPC of 115 TF capacity at its units in 2009. This was a part of a strategic plan for long term augmentation of HPC resources at ESSO Institutes.

The future improvement of weather prediction relies upon incorporating greater number of detailed physical processes into these models, and increased resolution of these models. This needs higher capacity HPC to provide more accurate and finer resolution forecasts to the user community. In view of this requirement, ESSO has recently procured 1.15 Peta Flops HPC systems to be setup at two of its Institutes (ESSO-Indian Institute of Tropical Meteorology (IITM), Pune and ESSO-National Center for Medium Range Weather Forecast (NCMRWF), Noida). The resources setup at these two institutes will be utilized by all units of ESSO through high-speed NKN network.

HPC installation at ESSO-IITM was inaugurated by Dr. Shailesh Nayak, Secretary of the Ministry of Earth Science (MoES), Chairman, Earth System Science Organization (ESSO), Chairman, Earth Commission on 28 February 2014. The newly augmented HPC installation at ESSO-IITM is named "AADITYA" (means SUN) to signify the major source of energy that drives our climate system. It is the most powerful High Performance Computing System in India at present. The Energy consumption will about 1.5-2 MW.

Details of the HPC System

The Aaditya HPC is a Highly Parallel Supercomputing System built on IBM System X technology. The compute performance is 790 Tera Flops with Intel Sandy bridge Processors. There are 2384 compute Nodes with each node having two 8 core Processors (Intel Xeon E5-2670 2.6GHz cache 20MB) and the Memory is 4 GB DDR3 per core and 64 GB per node. The total RAM/Memory of the cluster is more than 150 Tera bytes.

The System is having a 6 Peta bytes disk based storage solution built on IBM GSS technology with read and write performance of about 100 Gigabytes per second and the Tape Storage solution is based on Tivoli Storage 3500 tape library (Two Libraries) with Tivoli Storage Manager for automatic

backup and restore and HSM (Hierarchical Storage Management) functionalities. The Tape Library is scalable up to 100 Petabytes just by adding LTO6 Tape cartridges.

The compute, storage, master nodes and utility servers are connected over multiple Infiniband FDR switches for Inter Process Communication. The nodes are connected to the switches in a Fully Non-Blocking FAT Tree topology and is capable of delivering 56 Gbps end to end bandwidth.

The Operating environment is with Red Hat Enterprise Linux as Operating System, GPFS as the cluster Parallel file system, IBM XCAT as cluster administration and Management tool, UFM (Mellanox Unified Fabric Manager) for Fabric Management, Platform Load sharing facility (LSF) as the job scheduler and all other software, such as compilers, debuggers, profilers, MPI libraries, development environment are based on Intel Cluster Studio and IBM Parallel and Scientific Computation Environment.

Objective of this new HPC System:

- a) Enable simulations for improved weather, climate and ocean forecast and help in providing reliable weather and climate services to the end users such as farmers, fishermen and other stakeholders in the government and neighboring countries.
- b) Boost research in weather and climate forecasting as well as predicting air pollution.
- c) Improve assimilation of data from various platforms including aircraft, satellite, radar, ocean buoys, etc.
- d) Enable India to take part in the IPCC Assessment using an Indian Model and its own assessment.

Highlights:

This HPC facility will be useful for

1. Improving weather predictions and provide accurate forecasts at local levels utilizing finer resolution models.
2. Providing seasonal and extended range rainfall prediction of active/break cycles of Monsoon.
3. Air quality forecasting.
4. Climate projections.
5. Development of Earth System Model (ESM) which is a Global Model, including various components like Cryosphere, Biosphere, Geosphere, etc.

Various Universities/ Institutes engaged in related studies will also have access through National Knowledge Network (NKN) linkage.

Other details available at: http://www.tropmet.res.in/static_page.php?page_id=134