National Supercomputer Mission

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Why in News?

- India recently awarded French technology firm **Atos** the contract to build a network of 70 supercomputers across India under the **National Supercomputing Mission**.
- The first supercomputer designed and built under National Supercomputing Mission (NSM) by C-DAC at Indian Institute of Technology (BHU), Varanasi is named **"Param Shivay"**. It uses more than one lakh twenty thousand compute cores (CPU + GPU cores) to offer a peak computing power of **833 TeraFlops**.

A teraflop is a measure of a computer's speed equivalent to a trillion floating point operations per second. **It is a measure of the processing speed of computer**.

- The **Indian Institute of Technology, Kharagpur** is the first academic institution to get a supercomputing facility under the National Supercomputing Mission (NSM). Others will be set up in **IIT BHU** and **IIITM Pune**. While IIT BHU will get a one Petaflop supercomputer, the other two institutes will have 650 Teraflops each.
- This will provide large computational support to users to carry out both research and teaching activities that involve state-of-the-art **High Performance Computing (HPC)** at an estimated cost of Rs. 4500 crore over a period of seven years.

About The Mission

- The mission will nationally coordinate collaborative programme involving developers and users of supercomputing systems as well as academic and research institutions.
- It looks to facilitate effective governance and monitoring mechanisms to build culture of supercomputing for solving complex R&D problems and designing solutions addressing various country specific requirements for scientific, strategic and societal applications.
- The Mission envisages empowering our national academic and R&D institutions spread over the country by installing a vast supercomputing grid comprising of more than 70 high-performance computing facilities.

- These supercomputers will also be networked on the National Supercomputing grid over the **National Knowledge Network (NKN)**.
- The NKN is a central government initiative which connects academic institutions and R&D labs over a high speed network.
- Under NSM, the long-term plan is to build a strong base of 20,000 skilled persons. **PARAM Shavak** is one such machine that has been deployed to provide training.
- The mission will be implemented by the Department of Science and Technology (Ministry of Science and Technology) and Ministry of Electronics and Information Technology (MeitY), through the **Centre for Development of Advanced Computing (C-DAC)** and **Indian Institute of Science (IISc), Bengaluru**.

Introduction to NSM

- The first phase of the NSM is focused on assembling the supercomputers; the build element will be part of the second phase.
- As per the initial plan, while some components would be imported, some like server-board assemblies, cooling solutions, power supply and storage systems would be manufactured in India with an aim to make 50% of the components locally over time.
- The Centre for Development of Advanced Computing (C-DAC) is evaluating the technical bids by firms such as Acer, Fujitsu, IBM, HCL, TCS, Dell and Netweb and the contract is likely to be awarded soon.

Objective

- To make India one of the world leaders in Supercomputing and to enhance India's capability in solving grand challenge problems of national and global relevance.
- To empower our scientists and researchers with state-of-the-art supercomputing facilities and enable them to carry out cutting-edge research in their respective domains.
- The Mission also includes development of **High Performance Computing (HPC)** aware human resource for meeting challenges of development of these applications.
- To minimize redundancies and duplication of efforts, and optimize investments in supercomputing.
- To attain global competitiveness and ensure self-reliance in the strategic area of supercomputing technology.

Application Areas

- Climate Modelling.
- Weather Prediction.
- Aerospace Engineering including CFD, CSM, CEM.
- Computational Biology.

- Molecular Dynamics.
- Atomic Energy Simulations.
- National Security/Defence Applications.
- Seismic Analysis.
- Disaster Simulations and Management.
- Computational Chemistry.
- Computational Material Science and Nanomaterials.
- Discoveries beyond Earth (Astrophysics).
- Large Complex Systems Simulations and Cyber Physical Systems.
- Big Data Analytics.
- Finance.
- Information repositories/Government Information Systems.

Supercomputers in India

- India's supercomputer program was started in **late 1980s because Cray supercomputers** could not be imported into India due to an **arms embargo imposed on India,** as it was a dual-use technology and could be used for developing nuclear weapons.
- This led to setting up the **Centre for Development of Advanced Computing (C-DAC) in March 1988** with the clear mandate to develop an indigenous supercomputer to meet high-speed computational needs.
- **PARAM 8000**, considered to be India's first supercomputer was **indigenously built in 1991** by the Centre for Development of Advanced Computing (C-DAC).
- Presently, **Pratyush, a Cray XC40 system -** an array of computers that can deliver a **peak power of 6.8 petaflops,** installed at the **Indian Institute of Tropical Meteorology (IITM), Pune,** is the fastest supercomputer in India. Launched in January 2018, it is the **fourth fastest High Performance Computer (HPC) dedicated to climate modelling in the world**.

Global Rankings

India has its 5 supercomputers in the **TOP500 List** - June 2018 (released twice-yearly), of the world's most powerful supercomputers

39th RANK	Indian Institute of Tropical Meteorology India	**Pratyush -** Cray XC40, Xeon E5-2695v4 18C 2.1GHz, Aries interconnect Cray Inc.	4,006.2 TFlop/s

66th RANK	National Centre for Medium Range Weather Forecasting India	**Mihir -** Cray XC40, Xeon E5-2695v4 18C 2.1GHz, Aries interconnect Cray Inc.	2,808.7 TFlop/s
206th RANK	Software Company (M) India	**InC1 -** Lenovo C1040, Xeon E5-2673v4 20C 2.3GHz, 40G Ethernet Lenovo	1,413.1 TFlop/s
327th RANK	Supercomputer Education and Research Centre (SERC), Indian Institute of Science India	**SERC -** Cray XC40, Xeon E5-2680v3 12C 2.5GHz, Aries interconnect Cray Inc.	1,244.2 TFlop/s
496th RANK	Indian Institute of Tropical Meteorology India	**iDataPlex** DX360M4, Xeon E5-2670 8C 2.600GHz, Infiniband FDR IBM	790.7 TFlop/s

The *fastest* computer of the world is in the USA called - **SUMMIT**

1st RANK	DOE/SC/Oak Ridge National Laboratory United States	**Summit -** IBM Power System AC922, IBM POWER9 22C 3.07GHz, NVIDIA Volta GV100, Dual-rail Mellanox EDR Infiniband IBM	187,659.3 TFlop/s

Benefits

- This mission will bring India, a step closer, to be in the select league of few top nations (USA, China, Japan, etc.), having a large supercomputing power and improve its presence in the world of supercomputers.
- It supports the government's vision of **'Digital India'** and **'Make in India'** initiatives.
- India's large Scientific & Technology community will have access to SUPERCOMPUTING POWER necessary for developing applications in **Artificial Intelligence, Big Data, Cyber security,** etc.
- These machines will be part of the National Supercomputing grid over the **National Knowledge Network (NKN),** which will have wide-scale applications in the fields of climate modelling, weather prediction, aerospace engineering, computational biology, molecular dynamics, atomic energy simulations, national security and defence applications.
- NSM will improve the R&D ecosystem of Science & Technology within the country by satisfying the infrastructure need of the R&D sector. It will increase foreign investment

(FDI) in India in the R&D (services) sector by attracting foreign research companies to invest in India, especially in Pharmaceutical sector.

- Under NSM, the long-term plan is to build a strong base of 20,000 skilled persons who will be equipped to handle the complexities of supercomputers. They will be trained over the next five years and will become one of the largest ever dedicated human resource bases equipped to use these mighty computers.

Challenges

- **Multiple Agencies Involved:** There had been a number of delays over the past three years, largely because the project still doesn't have one dedicated person heading it. The NSM is to be jointly implemented by the Department of Science and Technology (DST) and Department of Electronics and Information Technology (DeitY) at an estimated cost of Rs 4,500 crore over a period of seven years. (2015-2022).
- **Funding:** Despite launching its supercomputer program in late 1980s, public awareness and interest has remained lukewarm, resulting in little funding in Research and development.
- **Import Dependent:** India's stronghold is in the field of software development, it has to depend on imports to procure the hardware components required for building supercomputers, and this is a drain on the resources.

Way Forward

- High-performance computing is important if India wants to make significant progress in areas like weather forecasting, drug discovery, astrophysics and bioinformatics.
- Favourable environment and funding in the field of science and technology will not only cut down India's dependence on foreign imports but will also bolster its goal of Make in India.
- Developing indigenous facilities will ensure that applications are tailored to address problems that are specific to India.