NATIONAL SUPERCOMPUTING MISSION - SCIENCE & TECHNOLOGY

National Supercomputing Mission Powers India's Research Ecosystem with 37 Systems, 40 Petaflops Capacity, Supporting Over 10,000 Researchers Across Diverse Fields. India's National Supercomputing Mission (NSM) aims for self-reliance in high-performance computing by creating a nationwide grid of supercomputers. A key success is the development of the fully indigenous 'PARAM Rudra' supercomputer, which supports extensive research and capacity building across the country.

National Supercomputing Mission (NSM) - Powering India's Technological Future

As of August 2025, India has successfully deployed 37 supercomputers under the National Supercomputing Mission (NSM), achieving a cumulative capacity of 40 Petaflops. This powerful high-performance computing (HPC) grid now supports over 10,000 researchers across more than 200 institutions, marking a significant milestone in the nation's scientific and technological advancement.

About the National Supercomputing Mission (NSM)

The NSM is a flagship initiative by the Government of India designed to establish a powerful and self-reliant supercomputing ecosystem in the country.

Core Objective - To empower the nation with state-of-the-art high-performance computing (HPC) capabilities, creating a robust infrastructure for advanced research and innovation. A petaflop is a unit of a supercomputer's processing speed, equivalent to one quadrillion (10^{15}) floating-point operations per second.

Launch and Budget - The mission was launched in April 2015 with a total outlay of ₹4,500 crore. It has since been extended until 31 December 2025.

Aim - To enhance India's technological prowess in supercomputing, foster a vibrant research and development (R&D) culture, and support critical scientific advancements across academia, industry, and government.

Vision - To achieve self-reliance (Atmanirbharta) and global leadership in supercomputing through indigenous design, development, manufacturing, and widespread network access.

Nodal Agencies - The mission is jointly implemented by the Ministry of Electronics and Information Technology (MeitY) and the Department of Science and Technology (DST), through their designated nodal institutions: the Centre for Development of Advanced Computing (C-DAC), Pune, and the Indian Institute of Science (IISc), Bengaluru.

Understanding Supercomputers

Supercomputers are highly advanced machines capable of performing trillions of calculations per second. They are specifically designed to solve complex scientific, engineering, and defence problems that are far beyond the capacity of ordinary computers.

Key Applications

Climate and Weather Forecasting - Crucial for accurate monsoon prediction, effective disaster management, and creating long-term climate change models.

Drug Discovery and Healthcare - Aid in complex tasks like genome sequencing, accelerated vaccine research, and molecular simulations for developing new medicines.

Defence and Space Research - Support vital operations such as cryptography, missile trajectory simulations, real-time satellite data processing, and intricate space mission planning.

Artificial Intelligence and Big Data Analytics - Enable cutting-edge applications like deep learning, large-scale data analysis, and the development of autonomous technologies.

Global and National Examples

World's Fastest Supercomputer (2025) - El Capitan, located at the Lawrence Livermore National Laboratory in the United States, has achieved a capacity of 1.742 exaflops. (1 Exaflop = 1,000 Petaflops, or 10^{18} calculations per second).

India's Indigenous Supercomputer - PARAM Rudra, developed indigenously under the NSM.

Deployment and Utilisation under NSM

The mission has successfully created a geographically distributed and highly utilized network of supercomputers.

System Spread - The systems are strategically installed in premier institutions like **IISc and IITs**, C-DAC centres, and R&D labs, with a focus on extending access to **Tier-II and Tier-III cities**.

High Efficiency - Most systems function at an impressive **85–95% utilisation rate**, having successfully completed over **1 crore compute jobs** for researchers.

Broad Research Support: Over **10,000 researchers**, including 1,700 PhD scholars, have directly benefited from this infrastructure.

Diverse Research Fields - Major applications include drug discovery, disaster management, climate modelling, energy security, astronomy, fluid dynamics, and material sciences.

Knowledge Output - The use of NSM-supported computing has resulted in the publication of more than **1,500 research papers**.

Industry Engagement - Startups and MSMEs are actively accessing the HPC systems to drive innovation and applied research.

Indigenous Technological Achievements

A core success of the NSM has been the creation of a self-reliant supercomputing ecosystem.

Self-Reliance Ecosystem - India has established end-to-end capabilities in the design, development, and manufacturing of supercomputing technologies.

PARAM Rudra - Deployed in 2024, this is the first fully indigenous supercomputer. It has been installed at the Giant Metrewave Radio Telescope (GMRT) in Pune, the Inter-University Accelerator Centre (IUAC) in Delhi, and the S.N. Bose Centre in Kolkata.

Indigenous Servers - PARAM Rudra is built using "Rudra" HPC servers, which are designed and manufactured in India and are on par with global standards. This strengthens the domestic electronics industry.

Complete Software Stack - A full suite of indigenous system software and domain-specific applications has been developed.

Trinetra Network - A high-speed interconnect with 40–100 Gbps bandwidth has been developed to enhance communication speed between supercomputing nodes.

Human Resource Development and Capacity Building

NSM places a strong emphasis on training and expanding access to build a skilled workforce.

Expanding Research Access - Researchers in smaller cities and non-metropolitan institutions now have access to advanced computing infrastructure that was previously unavailable.

Large-Scale Training - Over 26,000 individuals have been trained in HPC and AI through faculty development programs, workshops, hackathons, and bootcamps. Additionally, over 1,500 students have completed HPC courses through NPTEL (National Programme on Technology Enhanced Learning).

Nodal Centres for Training - Specialized training centres have been established at IIT Kharagpur, IIT Madras, IIT Goa, IIT Palakkad, Delhi Technological University (DTU), and Walchand College of Engineering.

Specialised Programs - C-DAC's Advanced Computing Training School (ACTS) offers a 6-month free Post Graduate Diploma in HPC for SC/ST/Women candidates, focusing on system administration and application development.

Compact Systems for Education - The mission has also developed PARAM Shavak, an energy-efficient desktop supercomputer designed for educational and research institutions to facilitate hands-on learning.

Strategic Significance of NSM

The National Supercomputing Mission is a cornerstone of India's technological and strategic ambitions.
Atmanirbhar Bharat - NSM is a powerful embodiment of the vision for technological self-reliance in the critical field of high-performance computing.
Global Competitiveness - It significantly enhances India's standing in frontier scientific research and strengthens its position in the global digital economy.
Inclusive Growth - By expanding access to HPC infrastructure for students, startups, MSMEs, and smaller institutions, the mission ensures broad-based and equitable capacity building across the country.

Conclusion

The National Supercomputing Mission has fundamentally transformed India's high-performance computing landscape. By fostering indigenous technology, enabling cutting-edge research across diverse domains, and expanding equitable access to a vast pool of talent, NSM has firmly positioned India as a self-reliant and influential global player in the future of supercomputing and digital scientific advancement.

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