7. National Supercomputing Mission- Science & Technology

India eyes fully indigenous supercomputing systems by 2030- ISM chief The National Supercomputing Mission (NSM) is a strategic initiative by DST and MeitY to establish a grid of over 70 indigenous high-performance computing systems, aiming for technological self-reliance in critical research areas. While it has achieved milestones like the "Trinetra" interconnect and "PARAM" series deployments, the mission faces hurdles such as continued dependence on imported semiconductor hardware and a shortage of skilled professionals.

National Supercomputing Mission (NSM)

Introduction- The National Supercomputing Mission (NSM) is a visionary initiative launched in 2015 to build a robust high-performance computing (HPC) ecosystem in India. It aims to position India as a globally competitive supercomputing nation by meeting the escalating computational demands of academia, researchers, and strategic sectors.

Implementation- Jointly implemented by the Department of Science and Technology (DST) and the Ministry of Electronics and Information Technology (MeitY).

Executing Agencies- Centre for Development of Advanced Computing (C-DAC) and Indian Institute of Science (IISc), Bengaluru.

Strategic Alignment- The mission aligns with the national visions of Digital India and Make in India.

Rationale for the Mission

Global Lag- Despite strong scientific manpower, India's presence in the global supercomputing arena was limited, with poor rankings in the "Top 500" list.

Data Dependency- The surge in data-intensive research (Big Data, AI) and strategic simulations (Defense, Space) necessitated a dedicated, national-level coordinated HPC infrastructure rather than relying on foreign facilities.

Core Objectives

Infrastructure Grid- To establish a nationwide grid of over 70 High-Performance Computing (HPC) systems.

Democratizing Access- To provide equitable access to supercomputing power for academic and R&D institutions via the National Knowledge Network (NKN).

Self-Reliance- To achieve technological self-reliance in designing and manufacturing supercomputers.

Problem Solving- To enable India to tackle large-scale, multidisciplinary challenges in science and society.

Application Areas- NSM supports computational research across a broad spectrum of critical sectors-

Climate & Earth Sciences- Weather forecasting, climate modelling, disaster prediction, and seismic analysis.

Healthcare- Computational biology, genomics, and drug discovery.

Strategic Sectors- Aerospace engineering, defence simulations, and atomic energy.

Emerging Tech- Big data analytics, Artificial Intelligence (AI), and finance.

Governance- E-governance systems and large system simulations.

Current Status & Achievements

Deployment- A total of 34 supercomputers have been deployed across IISc, IITs, C-DAC, and Tier-II/III institutions.

Capacity- The combined compute capacity stands at 35 Petaflops.

Key Installations

Param Pravega (2022)- Installed at IISc Bengaluru. With a capacity of 3.3 Petaflops, it is the largest supercomputer in an Indian academic institution.

AIRAWAT- A project initiated to provide a common AI research platform for labs, startups, and industry.

Trinetra- An indigenous high-speed communication network developed by C-DAC to enhance data transfer between computing nodes.

Importance of NSM

Feature	Significance
Indigenous Development	Reduces import dependence by prioritizing Indian hardware/software design.
Skill Development	Creates a pool of skilled HPC professionals (architects, admins, users).
Make in India	Encourages domestic manufacturing of servers (Rudra), processors, and system software.
Research Enablement	Powers cutting-edge research in AI, Machine Learning, and National Security.
Collaboration	Bridges the gap between academia (research) and industry (application).
Sustainability	Focuses on energy-efficient "Green Computing" to reduce environmental impact.

Phased Infrastructural Development

The mission follows a three-phase "Build and Buy" approach

Phase I- Initial Capability Building

Focus- Assembly of supercomputers using imported components.

Deployment- 6 Supercomputers.

Outcome- Established operational experience and system integration skills; laid the foundation for the grid.

Phase II- Partial Indigenisation

Focus- Shift towards local manufacturing and indigenous software.

Target- Indigenous content of roughly 40%.

Outcome- Development of domestic competence in system software, middleware, and server board manufacturing.

Phase III- Full Indigenisation

Focus- End-to-end indigenous design and manufacturing.

Target- Manufacturing of critical components like Processors (Server Class), Interconnects, and Servers within India.

Goal- A fully indigenous national-level supercomputing facility.

Indigenous Technologies under NSM

Trinetra (Communication Fabric)

Developer- C-DAC.

Function- An indigenous high-speed interconnect technology that links computing nodes for fast data transfer.

Development Stages

1. Trinetra-POC- Proof of Concept.
2. Trinetra-A- Early deployment.
3. Trinetra-B- Advanced implementation for large-scale systems.

PARAM Rudra Supercomputers

Hardware- Built on Rudra HPC servers, which are designed and manufactured in India.

Software- Runs on a fully indigenous software stack.

Benchmark- Rudra servers are the first Indian-made servers to meet international HPC performance standards.

Key Deployments

PARAM Shivay- The first supercomputer deployed under NSM (at IIT-BHU).

PARAM Pravega- The largest academic supercomputer (at IISc).

Challenges Facing NSM

Slow Deployment- The rollout speed has lagged behind initial timelines, delaying access for researchers.

Hardware Dependence- India still relies heavily on imports for the most critical component—semiconductor chips (processors and memory).

Funding Bottlenecks- Delays in fund release and procedural red tape have slowed procurement.
Manpower Shortage- There is a scarcity of experts trained in parallel programming, HPC architecture, and HPC-AI integration.
Infrastructure Constraints- High power consumption and cooling requirements are challenging to maintain, especially in remote Tier-II/III institutes.
Private Sector Lag- Limited participation from the private industry in leveraging these facilities for commercial innovation.

Conclusion

The National Supercomputing Mission is a cornerstone of India's technological sovereignty. By transitioning from a buyer to a builder of supercomputers, India is not only securing its strategic interests but also empowering its scientific community to solve complex problems. Overcoming the challenges of chip manufacturing and skilled manpower will be crucial for the mission to fully realize its potential of making India a global HPC power.

Source- https-//economictimes.indiatimes.com/tech/technology/india-eyes-fully-indigenous-supercomputing-systems-by-2030-ism-chief/articleshow/125895449.cms?from=mdr