

National Supercomputing Mission

Why in News?

Recently, Three PARAM Rudra supercomputers worth Rs 130 crore have been inaugurated.

What is a supercomputer?

- **Supercomputer** - It is a large computing system specifically designed to solve complex, scientific and industrial challenges, which tend to be time-consuming and computation-intensive.
- **Floating-Point Operations per Second (FLOPs)** - It is a measure of high-performance computing capability such as processing power, efficiency.
- Floating-point operations are a certain kind of mathematical calculation using real numbers with fractional parts.
- A petaflop is thus equal to a thousand TFLOPs or 10¹⁵ FLOPs.
- **Physical Size** - They take up a large room worth of space in the form of multiple rows with racks holding computer nodes with many cores.
- **High Performance Computing (HPC) system** - It is made up of several such supercomputers put together.
- New HPC Systems named 'Arka' and 'Arunika' were deployed at Indian Institute of Tropical Meteorology (IITM) at Pune and the National Centre for Medium Range Weather Forecasting (NCMRWF) at Noida.
- **HPC applications** - They will be developed and deployed in areas of
 - Computational biology
 - Climate modelling, weather prediction
 - Engineering including CFD, CSM, CEM
 - Disaster simulations and management
 - Computational chemistry and material science
 - Discoveries beyond Earth (Astrophysics)
 - Big data Analytics

Giant Metre Radio Telescope (GMRT) in Pune will leverage the supercomputer to explore Fast Radio Bursts (FRBs) and other astronomical phenomena.

What is National Supercomputing Mission?

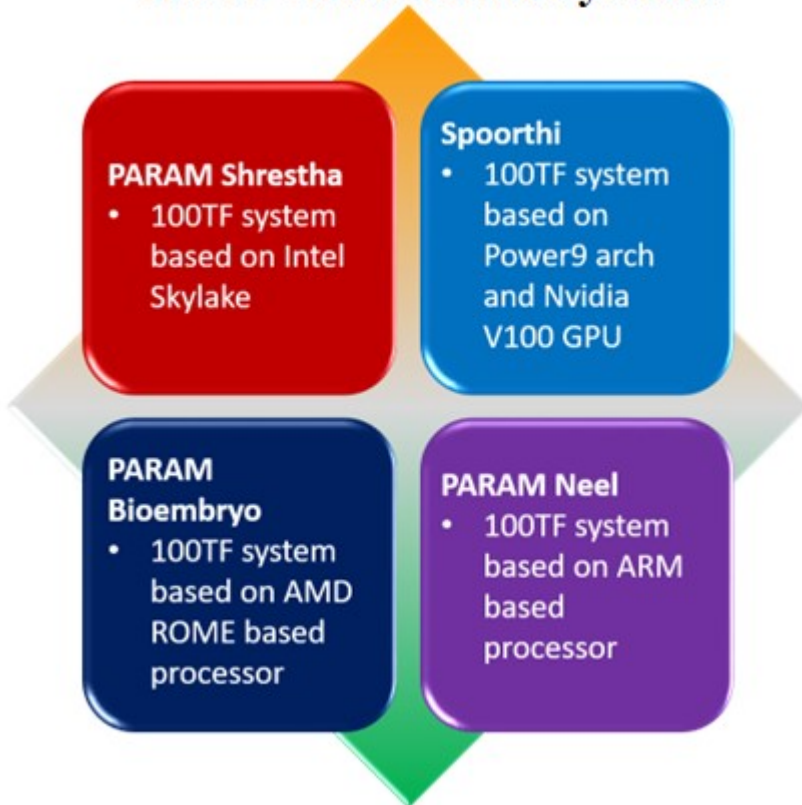
- **Aim** -To enhance the capabilities of Indian academic and R&D institutions by setting up a network of **over 70 high-performance computing (HPC) facilities** across the country.
- To boost India's supercomputing infrastructure amid increasing demand in sectors such as academia, researchers, MSMEs, and startups.

- It is a ***first of its kind attempt*** to boost the country's computing power.
- **Launched in** - 2015.
- **Developed by** - It is a collaboration between the Ministry of Electronics and Information Technology (MeitY) and the Department of Science and Technology (DST).
- **Implemented by** - The Centre for Development of Advanced Computing (C-DAC), Pune and the Indian Institute of Science (IISc), Bengaluru.
- **Network** - These supercomputers will also be networked on the National Supercomputing grid over the ***National Knowledge Network (NKN)***.
 - The NKN is another programme of the government which connects academic institutions and R&D labs over a high-speed network.
- Academic and R&D institutions as well as key user departments/ministries would participate by using these facilities and develop applications of national relevance.
- Under the mission, the first indigenously assembled supercomputer, named PARAM Shivay, was installed at IIT (BHU) in 2019.
- **Human Resource Training** - To train personnel in high performance computational skills, dedicated learning centres with PARAM Vidya were established.
- **R&D systems** - The SANGAM Testbed, PARAM Shrestha, PARAM Embryo, PARAM Neel, PARAM Spoorthi, PARAM Sampooran, are presently operational.

Supercomputers of India		
Supercomputer	Institute	Capacity and memory
PARAM Shivay	IIT BHU	837 teraflops and a total memory of 54.5 TB
PARAM Shakti	IIT Kharagpur	1.66 petaFLOPS and a total memory of 103.125 TB
PARAM Brahma	Indian Institute of Science Education and Research, Pune	1.75 petaFLOPS and a total memory of 56.8 TB
PARAM Yukti	Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore	1.8 petaFLOPS and a total memory of 52.416 TB
PARAM Sanganak	IIT Kanpur	1.67 petaFLOPS and a total memory of 104.832 TB
PARAM Pravega	Indian Institute of Science, Bangalore	3.3 petaFLOPS and a total memory of 245.945 TB
PARAM Seva	IIT Hyderabad	838 teraFLOPS and a total memory of 52.416 TB
PARAM Smriti	National Agri-Food Biotechnology Institute, Mohali	838 teraFLOPS
PARAM Utkarsh	CDAC, Bangalore	838 teraFLOPS and a total memory of 52.416 TB
PARAM Ganga	IIT Roorkee	1.66 petaFLOPS and a total memory of 104.832 TB
PARAM Ananta	IIT Gandhinagar	838 teraFLOPS and a total memory of 52.416 TB
PARAM Porul	NIT, Trichy	838 teraFLOPS
PARAM Himalaya	IIT Mandi	838 teraFLOPS and a total memory of 52.416 TB

PARAM Kamrupa	IIT Guwahati	838 teraFLOPS and a total memory of 52.416 TB
PARAM Siddhi	AI CDAC, Pune	5.2 petaFLOPS and 210 petaFLOPS (AI)
PARAM Rudra	Giant Metrewave Radio Telescope, Pune	1 petaFLOPS
	Inter-University Accelerator Centre, Delhi	838 teraFLOPS
	SN Bose National Centre for Basic Sciences, Kolkata	838 teraFLOPS
Mihir	NCMRWF	2.8 petaflop

100 TF Architecture Systems



What are the significances of the mission?

- **Indigenization** - The NSM has enabled indigenizing supercomputing technology in India.
- **Increased computational capability** - NSM has increased the computational capability for India as a whole.
- Since the launch of the programme, more than 20 supercomputing systems have been deployed nationwide.
- **Self-reliance** - Attain global competitiveness and ensure self-reliance in the strategic area of supercomputing technology.
- **Human Resource Development** - The Mission consists of development of highly

professional and skilled human resource for meeting the challenges of development of these applications.

- **Improved Weather Forecasts** - The HPC systems tailored for weather and climate research will enhance the accuracy and lead time of predictions related to tropical cyclones, heat waves, droughts, and other critical weather phenomena.
- **Research Advancement** - It will help advance research in fields ranging from physics and cosmology to earth sciences.

What are the challenges?

- **Incomplete utilization of funds** - The funds allocated to the National Supercomputing Mission in India has not been used fully leaving vast resources unused.
- **Delays in Procurement** -The lengthy procurement procedures of supercomputers and the attached infrastructure.
- **Skill Shortages** - Lack of experts and trained personnels in HPC programming, system administration, data science, and others.
- **Inadequate Private sector participation** - Due to the high cost and long-term nature of the projects, Indian private sectors are hesitant to invest in the technology.
- **Technological Dependency** - India's reliance on foreign suppliers for crucial components like processors and memory chips makes it vulnerable to supply chain disruptions and potential technology restrictions.
- **Power Supply** - Ensuring a reliable and uninterrupted power supply for high-performance computing centers is crucial.
- **Cooling Systems** - The massive heat generated by supercomputers requires efficient cooling systems, which can be expensive and energy-intensive.
- **Cybersecurity Threats** - Supercomputing centers are potential targets for cyberattacks, and protecting them requires advanced cybersecurity measures.

What lies ahead?

- Addressing these challenges requires a multi-faceted approach.
- Encourage private investments in research and development through public private partnerships and other partnership models.
- Conduct talent development programs in partnership with international organizations.
- Strengthen focus on cybersecurity in the domain of supercomputers
- By overcoming these hurdles, India can position itself as a global leader in supercomputing and leverage this technology for scientific advancement and economic growth.

References

1. [The Indian Express | National Supercomputing Mission](#)
2. [The Hindu | PARAM Rudra](#)



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