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.

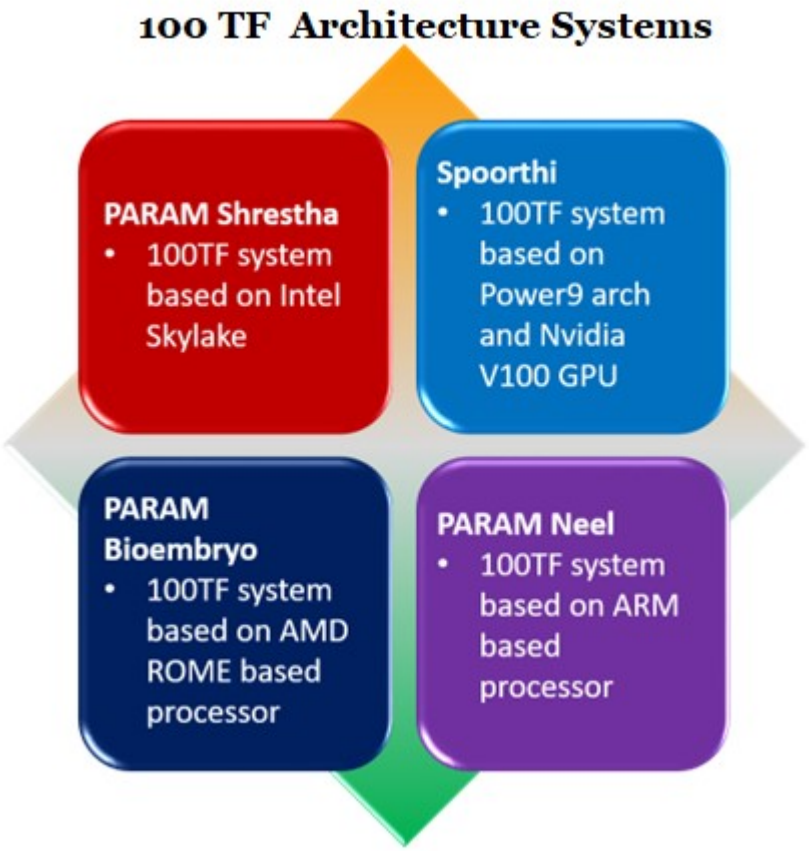
What is National Supercomputing Mission?

- **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



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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