

Supercomputer: In Indian Perspective

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Abstract - Supercomputing has had a profound impact on society, advancing scientific research, healthcare, climate change, national security, energy, and business. However, some concerns must be addressed to ensure that the benefits of supercomputing are distributed fairly and sustainably. Supercomputers are the future of the nation and the vehicle to make India Atma Nirbhar by shaking hands with the dreams of Digital India and Made in India.

Keywords: Supercomputer, Climate change, Digital India, Artificial Intelligence, Social Impact.

I. INTRODUCTION

Supercomputers are India's fastest computers and multiprocessor computers with very high processing speed and efficiency to process complex data information quickly and efficiently. They combine advanced technologies such as deep learning, Artificial Intelligence, Machine Learning, Cloud Computing, and more. India's fastest supercomputer is equipped with the latest and most developing technologies. The world's most memorable supercomputer "CDC 6600" was created to settle complex logical estimations and actual phenomena. A country around the world's most memorable supercomputer "CDC 6600" was created to address complex logical computations and actual phenomena. Countries all over the planet are creating supercomputers to make them all the more remarkable and resourceful because supercomputers are powerful enough to help a nation in complex areas that a generic computer could not imagine. India will develop 15 of latest by 2022 Supercomputers and the latest Indian supercomputer is PARAM Ananta. Digitization opens the door to digital data and data is the fuel of the future, which grows with the complexity of the service in every area. General computing is now, supercomputers focus on implementing Artificial Intelligence (AI) & Machine Learning (ML) technology as Artificial Intelligence implants human intelligence into the machine, creating can think and decide how humans can think and machine learning help machines learn from experiences. India's fastest supercomputer: PARAM Siddhi AI is also based on artificial intelligence. Supercomputers support complex areas such as weather forecasting, aerospace engineering, medical research, geolocation of oil and gas, and more. Supercomputers are the future of the nation and the vehicle to make India Atma Nirbhar by shaking hands with the dreams of Digital India and

Made in India. Supercomputers and the king of India's fastest supercomputers is "PARAMSiddhi-AI".

II. SUPERCOMPUTER

Supercomputers are high-power centralized computer, computers that can rapidly and proficiently compute complex information. Supercomputers are high-performance computers designed for complex and demanding computing tasks such as scientific simulations, weather forecasting, and cryptography. These systems use large arrays of processors and massive amounts of memory to achieve petascale processing speeds which means trillions of floating point operations per second. Some of the world's fastest supercomputers are found in countries like the United States, China, and Japan.

Development of the fastest supercomputer in India

The Indian government proposed different advancement programs to plan and create supercomputers. In 1987 alongside C-DAC other ventures like C-DOT, NAL, BARC, and ANURAG were commissioned for the same handle. India has made significant strides in the field of supercomputing in recent years.

Here are some of the fastest supercomputing systems in India:

- **Param Shakti:** It is a supercomputer developed by the Centre for Development of Advanced Computing (C-DAC) and is located at the Indian Institute of Technology (IIT) in Mumbai. It has a peak performance of 5.7 petaflops.
- **Param Shivay:** Developed by C-DAC and located at the Indian Institute of Science Education and Research in Bhopal, it has a peak performance of 1.2 petaflops.
- **PARAM8600:** In 1987, C-DAC planned a three-year mission for supercomputing machines for weather conditions gauging and scholastics. In 1991, India got its most memorable supercomputer PARAM 8000, with handling power in GFlops according to the principal mission of C-DAC. In 1992 India released PARAM 8600. First C-DAC mission. In 1992 India launched the PARAM8600.
- **Pratyusha:** This is India's fastest supercomputer, located at the Indian Institute of Tropical Meteorology in Pune. Its maximum performance is 6.8 petaflops.

- PARAM 9000:** The second mission of the C-DAC was the development 100 of GFLOPS supercomputers that made it possible for India with the PARAM 9000 in 1993 and the PARAM 10000 in 1998. India received its first world-class supercomputer, the PARAM Padma, in 2002 Completed the third C-DAC mission. PARAM Siddhi AI: In 2015, NSM was implemented in a seven-year development plan to install 73 native supercomputers to connect geographically distributed computers. India's achievements don't stop there and India The fastest supercomputer PARAM Siddhi AI is in action. It is a repack of 5.267 petaflops and its max 0.6 petaflops rmax and repak power measurement parameter evacuating in the supercomputer using the Linpack param benchmark. Sidhi AI is based on ARTIFICIAL INTELLIGENCE between 2012 and 2017; India completed a 12th five-year plan with IIS Bangalore to develop more powerful supercomputers with other mandates.

for a variety of applications including climate modeling and weather forecasting.

Param Shakti: This supercomputer developed by the Advanced Computing Development Center (C-DAC) is located at the Indian Institute of Technology (IIT) in Bombay. The Param Shakti has a maximum performance of 5.7 petaflops and is used for applications such as molecular dynamics simulations, data analysis, and artificial intelligence. Param Brahma: Another supercomputer developed by C-DAC, Param Brahma is located at the National Aerospace Laboratories in Bangalore. It has a maximum efficiency of 3.3 petaflops and is used for scientific and industrial applications such as aerodynamic simulations and materials science.

Param Ishan: Param Ishan was developed by C-DAC and is located at the Surat National Institute of Technology. Param Ishan has a peak performance of 1.4 petaflops and is used for a variety of applications including molecular dynamics simulation and seismic imaging. Peak performance 1.2 petaflops and is used for scientific simulations such as fluid dynamics and climate modeling.

III. THE FASTEST SUPERCOMPUTER IN INDIA

India has made great strides in high-performance computing in recent years, developing some of the fastest supercomputers in the country. Packed with cutting-edge technology, these supercomputers are used for a variety of scientific and industrial applications, including weather forecasting, climate research, aircraft design, and drug discovery.

Here's a more detailed look at some of India's fastest supercomputing systems:

Pratyush: This is India's fastest supercomputer and is located at the Indian Institute of Tropical Meteorology in Pune. Pratyush has a maximum power of 6.8 petaflops and is used

These supercomputing systems are essential tools for the advancement of science and technology in India. The development of these systems has enhanced India's capabilities in various fields and helped the country keep pace with global advances in high-performance computing. Overall, the development of India's fastest supercomputing systems is a testament to the country's commitment to scientific and technological advances and its potential to become a leader in supercomputing. With continued investment and support, India's supercomputing capabilities can grow and play an increasingly important role in scientific and technological advancement.

Table: 1

NAME	LOCATION	PEAK PERFORMANCE	APPLICATION ARE
Pratyush	India Institute of Metrology Pune	6.8	Weather forecasting
PARAM SHAKTI	Indian Institute of tech Mumbai	5.7	Molecular dynamics
Param Brahma	National Aerospace Bengaluru	3.3	Aerodynamics simulations
Param Ishan	National Institute of Technology, Surat	1.4	seismic imaging
Param Shivay	Indian Institute of Science Education and Research, Bhopal	1.2	climate modeling

IV. FEATURE OF THE FASTEST SUPERCOMPUTER IN INDIA

PARAM Siddhi AI ranks 63rd among the 500 fastest supercomputers in the world and is India's fastest supercomputer. Undistributed supercomputers are computers in which all processors are not geographically far apart and are located in the same place.

It is equipped with a three-layer security system to protect confidential data using artificial intelligence functions. PARAM, short for PARAllel Machine, means that all calculations are performed by parallel processing. The complex task is divided into parts and assigned to each processor. They combine the results of all processors to get the final result.

AI technology will support the R&D division, advance medical research, and improve flood-prone urban areas. It is from the PARAM series of supercomputers under the NSM of India. It is built with high accuracy and skills like deep learning, machine learning, visual reality, accelerated computing, and many more. It is the most outstanding and honorable achievement of Indian scientists and researchers.

V. NATIONAL SUPER COMPUTING INDIA

The National Supercomputing Mission (NSM) is a program initiated by the Government of India to boost the country's capabilities in high-performance computing. The goal of the program is to build a strong ecosystem of supercomputing in India and make the country a leader in the field of high-performance computing. The NSM was launched in 2015 to develop a network of supercomputing facilities across the Country, providing access to cutting-edge computing resources to researchers, academic institutions, and industries.

Under the NSM, the government has set up several supercomputing facilities in various parts of the country, including the Indian Institute of Technology (IIT) in Mumbai, the Indian Institute of Tropical Meteorology in Pune, and the National Aerospace Laboratories in Bengaluru. These facilities are equipped with some of the fastest supercomputing systems in the country, including Pratyush, Param Shakti, Param Brahma, and others.

The NSM also focuses on building the capacity of researchers, academic institutions, and industries in the field of high-performance computing. This is done through various initiatives, such as training programs, workshops, and collaborations with international research organizations. The program also aims to promote the development of supercomputing applications and technologies, with a focus on areas such as scientific simulations, weather forecasting, cryptography, and artificial intelligence.

The NSM has been instrumental in strengthening India's position in the field of high-performance computing and has helped the country to keep pace with the advancements happening globally in the field. With continued investment and support, the NSM has the potential to drive scientific and technological progress in India and help the country to become a leader in the field of supercomputing.

VI. APPLICATION OF THE AREA OF SUPERCOMPUTERS IN INDIA

Param Siddhi AI, India's fastest supercomputer is a moment of pride for the whole country and recognition for the entire design and development team. It will strengthen the

development of advanced materials, computational chemistry, and astrophysics applications. India's fastest supercomputer will be useful in many areas such as drug design, health systems, and flood forecasting in metropolitan.

The nation benefits from weather predicting capabilities, which also benefit agriculture and the lives of citizens. India's first goal in creating supercomputers was to independently forecast the weather to assist the country's population, which relies heavily on agriculture, and to show off its talented scientists as the winners and developers of more advanced systems.

Although the "Big Bang," or the first expansion of all energy and matter in the universe, occurred more than 13 billion years ago at temperatures of a trillion degrees Celsius, supercomputer models allow us to see what happened at the universe's creation. While scientists at NASA's Ames Research Center in Mountain View, Calif., have used supercomputers to mimic the formation of stars from cosmic dust and gas, researchers at the High level Figuring Place (TACC) at the College of Texas in Austin have additionally done likewise.

(i) Super Computer In space Development India

In India's space development efforts. Here are a few ways in which supercomputing has helped India's space program:

Design and Simulation: Supercomputing is used to design and simulate various aspects of India's space missions, from the behavior of spacecraft and satellites to the effects of the space environment on these systems. This allows engineers to optimize their designs and identify potential problems before a mission is launched, making the missions more successful and cost-effective.

Data Processing: Supercomputing is used to process large amounts of data generated by India's space missions, including data from remote sensing satellites, space probes, and space telescopes. This data is used for a variety of purposes, from monitoring the Earth's environment to studying the solar system and beyond.

Mission Planning: Supercomputing is used to plan India's space missions, including the launch window, trajectory, and payload. This allows missions to be optimized for maximum efficiency and cost-effectiveness.

Climate Modeling: Supercomputing is used to simulate the Earth's climate, helping researchers to understand the causes and effects of climate change. This data is used to inform decisions about India's space program and to support efforts to mitigate the effects of climate change.

Education and Training: Supercomputing is used to provide education and training to the next generation of space scientists and engineers. This includes training on the use of simulation and modeling tools, as well as exposure to the latest developments in space technology.

International Collaboration: Supercomputing is used to support international collaboration on space missions, including the sharing of data and the development of joint projects. This allows India to leverage the expertise of other countries and to participate in major international space initiatives.

Supercomputing has been instrumental in India's space development efforts, from design and simulation to data processing, mission planning, climate modeling, education and training, and international collaboration. As India's space program continues to grow and evolve, supercomputing will play an increasingly important role in advancing this critical area of technology and science.

(ii) Healthcare

Supercomputing is increasingly being used in healthcare to improve the diagnosis and treatment of diseases. Here a few ways in which supercomputing is having an impact:

Medical Imaging: Supercomputing is used to process and analyze medical images, such as MRI and CT scans. This allows doctors to more accurately diagnose diseases and monitor the progression of conditions such as cancer.

Drug Discovery: Supercomputing is used to simulate the behavior of molecules, helping researchers to develop new drugs and to optimize existing treatments. This includes the use of molecular dynamics simulations, which can be used to study the interactions of drugs with biological systems.

Genomics: Supercomputing is used to analyze large amounts of genetic data, helping researchers to understand the genetic basis of diseases and to develop new treatments. This includes the use of bioinformatics tools, which can be used to analyze large datasets and identify potential targets for drug development.

Clinical Trials: Supercomputing is used to simulate clinical trials, allowing researchers to test the safety and efficacy of new treatments before they are tested in humans. This helps to ensure that treatments are effective and safe, reducing the risk of adverse side effects and increasing the chances of success.

Electronic Health Records: Supercomputing is used to manage and analyze electronic health records (EHRs), allowing doctors and hospitals to manage patient information and improve the quality of care. This includes the use of data

analytics tools, which can be used to identify trends and patterns in patient data and to support decision-making.

Precision Medicine: Supercomputing is used to support precision medicine, which is an approach to healthcare that is tailored to the individual patient. This includes the use of genomics, medical imaging, and other data sources to develop personalized treatments that are tailored to the individual patient's needs.

However, with the increasing use of supercomputing in healthcare, some concerns must be addressed.

First concern is the privacy of patient data, which must be protected to ensure that patient information is not misused. Second concern is the accuracy of the information generated by supercomputing, as errors or biases in the data could have serious consequences for patient care.

Supercomputing is having a profound impact on healthcare, improving diagnosis and treatment of diseases, supporting drug discovery, genomics, clinical trials, electronic health records, and precision medicine. However, as the use of supercomputing in healthcare continues to grow, it is important to address the concerns about privacy and accuracy, to ensure that the benefits of supercomputing are distributed fairly and sustainably

(iii) National Security and Supercomputing Ensuring a Safe and Secure World

Supercomputing is playing an increasingly important role in national security, helping to ensure a safe and secure world. Here are a few ways in which supercomputing is contributing to national security:

Cybersecurity: Supercomputing is used to simulate and analyze complex cyber threats, allowing organizations to better understand the potential impact of cyberattacks and to develop effective strategies for defending against them. This includes the use of machine learning algorithms, which can be used to identify and respond to threats in real time.

Intelligence Gathering: Supercomputing is used to analyze vast amounts of intelligence data, allowing organizations to identify and respond to potential threats. This includes the use of big data analytics tools, which can be used to identify patterns and trends in large datasets, and natural language processing algorithms, which can be used to analyze unstructured data sources.

Weapon System Development: Supercomputing is used to design and simulate the behavior of weapon systems, allowing organizations to develop more advanced and effective weapons. This includes the use of computational fluid

dynamics simulations, which can be used to study the aerodynamics of weapons, and finite element analysis, which can be used to study the mechanical behavior of weapons.

Emergency Response: Supercomputing is used to support emergency response efforts, allowing organizations to respond more effectively to natural disasters and other emergencies. This includes the use of simulations, which can be used to predict the impact of disasters and to plan effective response strategies.

Border Security: Supercomputing is used to support border security, allowing organizations to monitor and respond to potential threats at the border. This includes the use of video analytics, which can be used to identify potential threats, and unmanned aerial vehicles (UAVs), which can be used to monitor remote areas.

However, with the increasing use of supercomputing in national security, some concerns must be addressed. One concern is the potential for the abuse of supercomputing, which could be used to violate civil liberties and human rights. Another concern is the potential for the development of autonomous weapons, which could be used to carry out military operations without human intervention.

Supercomputing is playing an important role in national security, helping to ensure a safe and secure world by supporting cybersecurity, intelligence gathering, weapon system development, and emergency response border security. However, as the use of supercomputing in national security continues to grow, it is important to address the concerns about abuse and the development of autonomous weapons, to ensure that the benefits of supercomputing are distributed fairly and sustainably

(iv) Miscellaneous Applications

Understanding earthquakes

Understanding earthquakes using supercomputers is a critical area of research in India, where earthquakes are a common natural disaster. Supercomputers can help scientists simulate and study earthquakes, providing a better understanding of the dynamics of these events and the forces that cause them.

Using simulations, scientists can model the behavior of the Earth's crust, tectonic plates, and faults, allowing them to make predictions about the likelihood and severity of earthquakes. These simulations can also help researchers understand the impact of earthquakes on buildings and infrastructure, and help inform construction standards and disaster response planning.

In India, supercomputers are being used to study earthquakes in the Himalayan region, where the collision of tectonic plates has caused some of the world's most powerful earthquakes. These simulations are providing insights into the behavior of the plates and help researchers to identify potential seismic hazards.

The use of supercomputers in earthquake research is important for improving our ability to predict and prepare for these natural disasters. By increasing our understanding of earthquakes, with the help of supercomputer Human can reduce earthquake impact on communities and save lives. The use of supercomputers in India is a positive step forward in this direction.

Forecasting hurricanes

Understanding and forecasting hurricanes using supercomputers is an important area of research in India, where hurricanes can cause significant damage to coastal communities. Supercomputers provide the computational power necessary to run complex simulations of hurricanes, allowing scientists to study the behavior of these storms and make accurate predictions about their path and intensity.

By incorporating data from a variety of sources, such as satellite imagery and ocean temperature data, scientists can create realistic simulations of hurricanes and improve their understanding of these storms. This information can then be used to provide early warning systems and help communities prepare for the potential impact of a hurricane.

The use of supercomputers in hurricane research is crucial for improving our ability to predict and respond to these natural disasters. By using the latest technology, researchers in India are helping to minimize the impact of hurricanes and save lives.

Predicting climate change

One of the major problems facing humanity now is climate change. The use of supercomputers has revolutionized our ability to predict the impacts of climate change. With the help of these machines, scientists are able to simulate the Earth's climate system with increasing accuracy. They can run complex models that take into account factors such as greenhouse gas emissions, ocean currents, and atmospheric circulation patterns.

Supercomputer simulations have shown that the Earth's average temperature is likely to increase by 2-4°C by the end of the century if greenhouse gas emissions continue to rise. This will result in more frequent and intense heat waves,

droughts, and storms. It will also cause sea levels to rise, leading to coastal flooding and erosion.

However, supercomputer simulations also offer hope. They can help us identify the most effective ways to reduce greenhouse gas emissions and mitigate the impacts of climate change. For example, they can show us which energy sources are the most efficient and cost-effective, and how human can transition to a low-carbon economy.

Building brains

Building a brain using a supercomputer is a complex and ambitious project that has the potential to revolutionize our understanding of the human mind. The goal of this research is to create a computer-based simulation of the human brain, known as a "brain model" or "brain simulation."

Supercomputers have the computational power necessary to run complex simulations of the brain's neural networks. These simulations take into account the various components of the brain, including neurons, synapses, and neurotransmitters. By running simulations at the scale of the human brain, researchers hope to gain new insights into how the brain processes information, makes decisions, and generates behavior.

There are several challenges associated with building a brain using a supercomputer. One of the biggest challenges is obtaining accurate data about the brain. Another challenge is designing a simulation that accurately captures the interactions between different parts of the brain. Finally, researchers must also ensure that the simulation is able to run efficiently on a supercomputer, taking into account the available memory and processing Power. Despite these challenges, the potential benefits of building a brain using a supercomputer are substantial. Research could lead to a better understanding of brain diseases, such as Alzheimer's and Parkinson's, and could help develop new treatments. It could also have applications in the fields of Artificial Intelligence and robotics, leading to the development of more advanced and capable machines.

VII. FUTURE OF SUPER COMPUTING

Promising, as advancements in technology, continue to drive the development of faster and more powerful computers. Here are a few key trends that are shaping the future of supercomputing:

Increased Use of Artificial Intelligence: AI is expected to play a major role in the future of supercomputing, as more and more organizations use machine learning algorithms to process large amounts of data. This will require even more

computing power, and supercomputers are expected to be at the forefront of this trend.

Development of Quantum Computing: Quantum computing has the potential to revolutionize the way supercomputers process information. With the ability to solve complex problems much faster than classical computers, quantum computing is expected to become a key component of future supercomputing systems.

Expansion into Cloud Computing: As more organizations adopt cloud computing, supercomputers are likely to follow suit. This will allow organizations to access the power of supercomputing from anywhere, making it easier for organizations to take advantage of this technology.

Increased Use of High-Performance Computing: High-performance computing (HPC) will continue to be a key component of future supercomputing systems. This will allow organizations to process complex data and simulations more quickly, making it easier to develop new technologies and products.

Advancements in Energy Efficiency: As energy costs continue to rise, it will become increasingly important to develop supercomputers that are energy efficient. This will be achieved through the use of new materials and technologies, such as photonics and quantum computing, that are less energy-intensive than traditional computing methods.

VIII. SOCIAL IMPACT OF SUPER COMPUTER

Supercomputing has had a significant impact on society in many different ways. Here are a few examples:

Scientific Research: Supercomputers have been instrumental in advancing scientific research in fields such as climate modeling, protein folding, and genomics. By processing large amounts of data, supercomputers allow scientists to make discoveries and develop new technologies that would not be possible with traditional computing methods.

Healthcare: Supercomputing has been used to develop new treatments for diseases and to improve medical diagnosis. For example, supercomputers have been used to simulate the spread of diseases, helping researchers to develop more effective treatments and vaccines.

Climate Change: Supercomputing is critical in understanding and mitigating the effects of climate change. Climate models powered by supercomputers are used to simulate the Earth's climate, helping scientists to understand the causes of climate change and to develop strategies to address it.

National Security: Supercomputing plays an important role in ensuring national security. For example, supercomputers are used to simulate the behavior of weapons, helping to design and test new weapons systems.

Energy: Supercomputing is used to optimize the production and distribution of energy, making it more efficient and sustainable. For example, supercomputers are used to simulate the behavior of oil and gas reservoirs, helping to maximize their production and minimize waste.

Business: Supercomputing is increasingly being used by businesses to gain a competitive edge. For example, financial companies use supercomputers to simulate market conditions and to develop new investment strategies.

However, with the increasing use of supercomputing, some concerns must be addressed. One concern is the energy consumption of supercomputers, which can be substantial.

Another concern is the potential for job displacement, as automation and artificial intelligence powered by supercomputing may displace workers in certain industries. Additionally, the concentration of supercomputing power in the hands of a few organizations raises questions about privacy and security.

National security: Supercomputers are also used in national security, such as in the analysis of satellite data and the simulation of battlefield scenarios. Overall, supercomputers are a vital tool for India to advance in various fields and make better decisions for the country's development.

Economical: Supercomputers can play a significant role in driving economic growth in a variety of ways. One of the most significant ways is through their use in research and development. Supercomputers can be used to run simulations and models that aid in the development of new products, processes, and technologies. For example, they can be used to simulate the behaviour of molecules and proteins, which can aid in the development of new drugs. They can also be used in the design and testing of new materials, such as those used in the aerospace and automotive industries. Another way supercomputers can drive economic growth is through their use in data analysis. Supercomputers can process large amounts of data quickly and accurately, which can be used to make better business decisions and drive innovation. This can be especially beneficial in industries such as finance and retail, where companies can use data to identify trends and make predictions about consumer behaviour.

Supercomputers can also be used in weather forecasting and climate modelling. Accurate forecasting can help industries such as agriculture, transportation, and energy plan

for future weather events and make better decisions. Additionally, climate modelling can help to plan for and mitigate the effects of climate change, which can have a significant impact on the economy. Supercomputers can also be used to improve the efficiency of existing processes and infrastructure. For example, they can be used to optimize supply chains, logistics, and manufacturing processes to reduce costs and improve productivity. Additionally, they can be used to improve the efficiency of energy systems, such as power grids, which can help to reduce costs and improve the reliability of energy supplies.

Overall, supercomputers are a powerful tool that can be used to drive economic growth in a variety of ways. They can aid in the development of new products, processes, and technologies; improve the efficiency of existing processes and infrastructure; and help to make better decisions based on data analysis. With the help of supercomputers, India can take its economy to the next level and be at par with leading countries. **Development in GDP Growth of Supercomputer:** Supercomputers can play a significant role in the development of India's GDP. The use of supercomputers in research and development can lead to the creation of new products, processes, and technologies, which can drive economic growth. Supercomputers can process large amounts of data quickly and accurately, which can be used to make better business decisions and drive innovation. This can be especially beneficial in industries such as finance and retail, where companies can use data to identify trends and make predictions about consumer behaviour.

Supercomputers can also be used to improve the efficiency of existing processes and infrastructure.

Supercomputer can be used to optimize supply chains, logistics, and manufacturing processes to reduce costs and improve productivity. Additionally, they can be used to improve the efficiency of energy systems, such as power grids, which can help to reduce costs and improve the reliability of energy supplies. Moreover, supercomputers can aid in the field of Artificial Intelligence and Machine Learning, which is a rapidly growing industry in India. This can lead to the development of new products and services, which can drive GDP growth.

Supercomputers can play a significant role in the development of India's GDP by driving economic growth in a variety of ways such as new product development, data analysis, improving the efficiency of existing processes and infrastructure, and fostering the growth of new industries such as AI and ML. The Indian government has been investing in the development of supercomputers and their related

infrastructure, which will help India to increase its GDP and be at par with leading countries in the world.

IX. LIMITATIONS OF SUPERCOMPUTER

One major limitation is the cost of building and maintaining a supercomputer. These machines require significant investments of both money and resources to construct and operate. They consume large amounts of energy, which can further add to the overall cost.

Another limitation is the scalability of supercomputers. While they are capable of performing large-scale calculations and simulations, they are not always able to handle the increasing amounts of data being generated by scientific experiments and other research.

This can lead to limitations in the types of problems that can be solved using supercomputers

Another limitation is the complexity of the software and hardware required to operate a supercomputer. The software used to run supercomputers is often highly specialized and requires a significant amount of expertise to understand and use effectively. The hardware used in supercomputers is often proprietary and not compatible with other systems, making it difficult to share data or collaborate with other researchers.

Supercomputers are also limited by the physical space they require. They are often housed in large, specialized facilities that are not always easily accessible to all researchers. This can make it difficult for scientists and engineers to conduct experiments or perform simulations that require the use of a supercomputer.

Supercomputers are also limited by their processing power, which is still far from the human brain, and their ability to perform certain tasks such as pattern recognition, decision-making and problem-solving is limited.

While supercomputers are incredibly powerful tools for performing complex calculations and simulations, they are also subject to several limitations, including cost, scalability, complexity, physical space, and processing power. These limitations may limit the types of problems that can be solved using supercomputers and make it difficult for researchers to access and utilize these powerful machines.

X. FUTURE OF SUPERCOMPUTER

The future of supercomputing is full of exciting possibilities. With the increasing use of AI, quantum computing, cloud computing, HPC, and advancements in energy efficiency, supercomputers are expected to become even more powerful, efficient, and accessible in the years.

- Supercomputers have certain distinguishing features. Dissimilar to traditional PCs, they generally have more than one computer chip (focal handling unit), which contains circuits for deciphering program guidelines and executing math and rationale tasks in a legitimate grouping.
- The utilization of a few computer chips to accomplish high computational rates is required by the actual furthest reaches of circuit innovation.
- Electronic signal can't travel quicker than the speed of light, which subsequently is a basic speed limit for signal transmission and circuit exchanging.
- This cutoff has nearly been reached, attributable to the scaling down of circuit parts, emotional decrease in the length of wires interfacing circuit sheets, and development in cooling strategies (e.g., in different supercomputer frameworks, processor and memory circuits are submerged in a cryogenic liquid to accomplish the low temperatures at which they work quickest.
- Fast recovery of put-away information and guidelines is expected to help the very high computational speed of central processors. Thusly, most supercomputers have an exceptionally huge capacity limit, as well as an extremely quick.
- **Specialized hardware:** Supercomputers often include specialized hardware, such as graphics processing units (GPUs) or field-programmable gate arrays (FPGAs), to perform specific tasks.
- **Security:** Supercomputers have robust security features to protect sensitive data, including firewalls, encryption, and secure access controls.
- **Parallel processing:** Supercomputers use parallel processing, where multiple processors work together to perform a task, making them much faster than traditional computers.
- **Large memory capacity:** They have a large memory capacity, allowing them to store and process vast amounts of data.
- High-performance data from a variety of sources come from computing Supercomputers are designed for high-performance computing, capable of performing millions of calculations per second.
- **Virtualization:** Supercomputers can support virtualization, allowing multiple users to access the system simultaneously and reducing hardware costs.
- **Specialized hardware:** Supercomputers often include specialized hardware, such as graphics processing units (GPUs) or field-programmable gate arrays (FPGAs), to perform specific tasks.

XI. CONCLUSION

In conclusion, the proliferation of supercomputers in India has enabled the country to take significant strides in the fields of science, technology, engineering, environment, medical etc. Supercomputers have enabled India to be at the forefront of research in many fields, and have allowed the country to develop new methods and technologies that have greatly benefited society.

Supercomputing has had a profound impact on society, advancing scientific research, healthcare, climate change, national security, energy, and business. However, some concerns must be addressed to ensure that the benefits of supercomputing are distributed fairly and sustainably.

India is now home to some of the most powerful supercomputers in the world, and the country continues to invest heavily in the development of these machines, which will no doubt continue to bring great benefit to the nation.

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