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EMERGING SPACE BRIEF

High-Performance Computing

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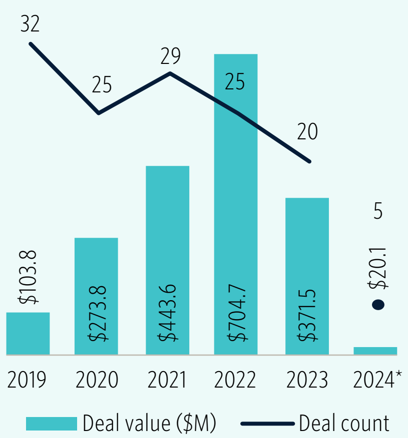
Trending companies

HUT 8
InspireSemi
Hyperion Research
Applied Digital
PASQAL
ALTAIR

HPC VC deal activity



Source: PitchBook • Geography: Global
*As of June 4, 2024

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Overview

High-performance computing (HPC) refers to the use of powerful processors, networks, and storage systems to solve complex computational problems. HPC systems can process large amounts of data at high speeds, making them essential for scientific research, engineering, and various industries.

Background

HPC has its roots in the 1960s with the creation of the CDC 6600 supercomputer. The 1980s and 1990s saw significant advancements with massive parallel processing and distributed computing, making HPC more accessible and cost-effective. The 2000s introduced petascale computing, highlighted by IBM's Roadrunner, and efforts are now focused on exascale computing. HPC's rapid growth is driven by the explosion of data in genomics, AI, and other fields, along with advancements in processors, networking, and storage technologies. The rise of cloud-based HPC solutions has lowered entry barriers, enabling startups to access powerful computing resources. Industries like automotive, aerospace, and finance are increasingly adopting HPC for complex simulations and data analysis.

Technologies and processes

Advanced processors

- **Multicore central processing units (CPUs):** HPC systems utilize processors with multiple cores, allowing for parallel processing and the execution of multiple tasks simultaneously.

- **Graphics processing units (GPUs):** Initially designed for rendering graphics, GPUs are now crucial in HPC for their ability to handle large-scale computations efficiently.

- **Specialized accelerators:** Devices such as field-programmable gate arrays (FPGAs) and tensor processing units (TPUs) offer tailored computational capabilities, which are particularly beneficial for AI & machine learning (ML) applications.

High-speed networking

- **InfiniBand and high-performance Ethernet:** These technologies ensure rapid data transfer between nodes in an HPC cluster, reducing latency and maintaining synchronization across the system. High-speed interconnects are essential for the performance of distributed computing tasks.

Robust storage solutions

- **Solid-state drives (SSDs):** SSDs provide the high throughput necessary for fast data access, which is crucial for handling the large datasets typical in HPC applications.

- **Parallel file systems:** Systems such as Lustre and GPFS are designed to distribute data across multiple storage devices, enabling concurrent access and reducing bottlenecks, which enhances overall system efficiency.

Optimized software

- **Middleware and job schedulers:** Tools like Slurm and Torque manage job distribution and resource allocation, ensuring efficient use of computational resources.

- **Optimized libraries:** Libraries such as Message Passing Interface (MPI) and Compute Unified Device Architecture (CUDA) provide optimized functions for parallel processing, maximizing the performance of HPC systems.

Cloud-based HPC

- **Cloud computing:** The rise of cloud computing has revolutionized HPC by offering scalable, on-demand computing resources. Major providers like Amazon Web Services, Microsoft Azure, and Google Cloud allow organizations to access HPC capabilities without significant up-front investments in infrastructure. This democratizes access, particularly benefiting startups and smaller enterprises.

Applications

HPC plays a critical role in various industries by providing the necessary computational power for complex and data-intensive tasks. In scientific research, it supports detailed climate modeling and facilitates DNA sequencing and analysis in genomics. The automotive and aerospace industries use HPC for design optimization, simulations, and testing, while materials science benefits from it for the development of new materials. Financial services employ HPC for risk modeling, high-frequency trading, and fraud detection. In healthcare, HPC accelerates drug discovery processes and enhances the analysis of medical images. It also supports AI & ML through the training of sophisticated models and Big Data analysis. The entertainment industry leverages HPC for rendering visual effects and animations, and streaming services utilize it for efficient content delivery. These diverse applications demonstrate HPC's widespread impact and its significant potential for driving advancements across various sectors.

Limitations

Like any complex system, HPC also faces several limitations that impact its adoption and efficiency. One significant challenge is the high cost associated with building and maintaining HPC systems. The investment required for advanced processors, high-speed networking, and robust storage solutions can be substantial, which may be prohibitive for smaller organizations. Additionally, operational expenses, including energy consumption, cooling, and ongoing maintenance, contribute to the overall cost. The complexity of integrating and managing HPC infrastructure also poses a barrier. Effective use of HPC resources requires specialized knowledge and expertise, often necessitating significant investment in skilled personnel or training programs. Furthermore, developing and optimizing software for HPC systems can be intricate, as it involves leveraging parallel processing and managing distributed computing environments.

Energy consumption is another critical issue, with HPC systems demanding large amounts of electricity, leading to high operational costs and environmental concerns. The sustainability of HPC operations is increasingly under scrutiny, with efforts to improve energy efficiency and adopt renewable energy sources adding to the complexity and cost. Scalability presents additional challenges; while cloud-based HPC solutions offer flexibility, on-premises systems may struggle to scale efficiently with growing computational demands. Efficiently allocating and managing resources to avoid bottlenecks and ensure optimal performance requires sophisticated tools and careful planning.

Security concerns also play a significant role, as HPC systems often handle sensitive and proprietary data, making them targets for cyberattacks. Ensuring robust security measures and compliance with data protection regulations can increase the operational burden and complexity. These limitations must be carefully considered by stakeholders to maximize the value and efficiency of HPC deployments, balancing the substantial benefits against the challenges they present.

Recent deal activity and market outlook

The HPC market is seeing notable investment activity, reflecting its expanding role in various industries. Recently, Simr, which develops cloud-based software for engineering applications to scale up HPC systems, secured $20.0 million in Series A funding led by Uncorrelated Ventures, with contributions from Earlybird Venture Capital and BMW i Ventures. This funding will facilitate Simr's operational expansion and further development of its platform, which aims to improve the efficiency of complex mathematical models and simulations for engineers and scientists.

Similarly, Crusoe, which operates mobile modular datacenters that utilize wasted natural gas for HPC systems, raised $14.0 million in debt financing on March 1, following a $200.0 million mezzanine round in October 2023. These funds will be used to acquire NVIDIA GPUs, enhancing Crusoe's capacity to provide cost-effective and environmentally friendly computing solutions.

The HPC market is expected to grow significantly, driven by increasing data volumes, advancements in AI & ML, and the demand for sophisticated simulations. Cloud-based HPC solutions are lowering barriers to entry, enabling startups and smaller enterprises to access powerful computing resources. However, challenges such as high costs, complexity, and energy consumption remain significant. Addressing these challenges is crucial for the sustainable growth of HPC technologies. Overall, the HPC market presents substantial opportunities for both investors and innovators, with continued advancements and wider adoption across various sectors.

For a deeper dive into the data and to explore additional insights, visit the PitchBook Platform or request a free trial.

Quantitative perspective*

282 companies	370 deals	446 investors	$4.1B capital invested
20 deals (TTM) -37.5% YoY	$7.2M median deal value (TTM) -5.6% YoY	$37.6M median post-money valuation (TTM) 7.4% YoY	$347.3M capital invested (TTM) -5.2% YoY

*As of June 4, 2024

Top HPC companies by total raised*

Company	Total raised ($M)	Last financing value ($M)	Last financing date	Last financing deal type	HQ location	Year founded
Crusoe	$908.1	$200.0	October 23, 2023	Mezzanine	Denver, US	2018
Altair Engineering	$334.9	$200.0	September 27, 2021	PIPE	Troy, US	1985
Hut 8 Mining	$249.9	$95.1	June 15, 2021	Public investment second offering	Toronto, Canada	2017
Pasqal	$147.8	$2.6	December 1, 2022	Grant	Massy, France	2019
AkroStar	$139.2	$77.3	May 19, 2021	Early-stage VC	Zhuhai, China	2020
SiPearl	$131.2	$104.0	April 5, 2023	Early-stage VC	Maisons-Laffitte, France	2019
Cornami	$124.1	$13.4	April 19, 2023	Late-stage VC	Dallas, US	2011
Paratera	$111.5	$39.9	November 1, 2023	IPO	Beijing, China	2007
Linux NetworX	$109.8	N/A	February 14, 2008	M&A	Bluffdale, US	1989
Applied Digital	$89.0	$40.0	April 13, 2022	Public investment second offering	Dallas, US	2001

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Top HPC companies by Exit Predictor Opportunity Score*

Company	Opportunity Score	Success probability	M&A probability	IPO probability	Total raised ($M)	HQ location	Year founded
YellowDog	97	92%	91%	1%	$10.6	Bristol, UK	2015
Ori Industries	96	91%	89%	2%	$15.2	London, UK	2018
Simr	96	91%	90%	1%	$27.5	Los Altos, US	2012
CIQ	94	88%	87%	1%	$30.0	Reno, US	2020
Pasqal	93	98%	48%	50%	$147.8	Massy, France	2019
LESSENGERS	87	77%	72%	5%	$7.7	Pohang, South Korea	2017
Agnostiq	86	78%	77%	1%	$12.0	Toronto, Canada	2018
Crusoe	86	98%	18%	80%	$908.1	Denver, US	2018
Fathom Radiant	86	79%	78%	1%	$11.8	Boulder, US	2014
Qarnot	69	81%	75%	6%	$55.4	Roubaix, France	2010

Source: PitchBook • Geography: Global • *As of June 4, 2024
Note: Probability data is based on PitchBook VC Exit Predictor methodology.

Top HPC companies by active patents*

Company	Active patent documents	Total raised ($M)	HQ location	Year founded
Altair Engineering	155	$334.9	Troy, US	1985
Cornami	103	$124.1	Dallas, US	2011
Graphics Properties Holdings	92	N/A	Mountain View, US	N/A
Tomologic	40	N/A	Stockholm, Sweden	2008
DUG Technology	34	$33.1	West Perth, Australia	2003
Mill Computing	34	$3.2	Palo Alto, US	2003
Lectenz Bio	20	N/A	Athens, US	2007
Supercomputing Systems	14	N/A	Zurich, Switzerland	1993
Crusoe	12	$908.1	Denver, US	2018
Numascale	10	$8.4	Oslo, Norway	2008
Qarnot	10	$55.4	Roubaix, France	2010

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Top HPC investors*

Investor(s)	Investments	Primary investor type	HQ location
Earlybird Venture Capital	8	VC	Berlin, Germany
European Innovation Council Fund	8	VC	Brussels, Belgium
Small Business Innovation Research and Small Business Technology Transfer Programs	8	Government	N/A
Bpifrance	5	Sovereign wealth fund	Paris, France
DT Lake Equity Investment	5	VC	Shanghai, China
Founders Fund	5	VC	San Francisco, US
Quantonation	5	VC	Paris, France
Spring Lake Equity Partners	5	PE/buyout	Boston, US
US Department of Energy	5	Government	Washington, DC, US

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Recommended reading

- "History and Overview of High Performance Computing," Gordon College, Parallel and High Performance Computing, Spring 2020.
- "High-Performance Computing," NVIDIA, n.d., accessed June 4, 2024.
- "An Action Plan for High Performance Computing Security," National Institute of Standards and Technology, November 2016.