Market Forecast

HPC Cloud Market Spending Size and Forecast, 2013 to 2022

Alex Norton, Bob Sorensen, Steve Conway, and Earl Joseph
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HYPERION RESEARCH OPINION

This report covers Hyperion Research market sizing and market projection for HPC spending in public clouds. The use of public clouds for HPC workloads has been growing, primarily as more user sites transition from running small experiments to running major problems in public clouds.

- Hyperion Research expects public clouds to become a better fit for a broader set of HPC workloads in the future, as they evolve to be more capable at running technical computing problems cost- and time-effectively.

This report focuses on the market for public cloud usage by HPC user organizations, developed from data from multiple years of our surveys and interviews with users. Hyperion Research estimates that worldwide end user spending for HPC usage in public clouds was just under $1.9 billion in 2017. Given the healthy growth rates of the past five years and projected continuation of strong growth, Hyperion Research projects that end user spending on HPC in public clouds will be over $5.5 billion by 2022.

- When this cloud figure is added to the spending for HPC servers, middleware, applications, storage and services, we project that the overall total HPC market will grow from $26 billion in 2017 to $44 billion in 2022 (11.1% CAGR).

To date, HPC usage in public clouds has been more wide than deep. Although the percentage of HPC sites running one of more workloads in a public cloud jumped from 13% in 2011 to 64% in 2017, the average percent of the sites' total HPC workloads sent to public clouds has risen more slowly and today stands at just below 10%. Hyperion Research's recent private studies of HPC use in public clouds consistently indicate that about 40% of HPC sites worldwide do not run any of their workloads in public clouds (more than benchmarking tests), with data security remaining as the primary obstacle despite steady improvements in security by cloud services providers (CSPs).

Hyperion Research notes that the public cloud sector may be approaching an acceleration phase in growth:

- First, Hyperion Research recent studies show that on average, the roughly 60% majority of HPC sites that exploit public clouds will increase the fraction of all their HPC workloads run in public clouds from today's sub-10% to 14-15% in just the next two years.
- Second, and in the long run more important, major CSPs are now competing to make their offerings friendlier to a broader spectrum of HPC workloads by enhancing their architectures with more-capable networking (e.g., "direct connect" options) and offering greater processor choices and more-effective software stacks.
- Smaller, intermediary CSPs are also improving their support for helping HPC users move their appropriate workloads to public cloud environments.

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SITUATION OVERVIEW

This report covers Hyperion Research market sizing and market projection for HPC spending in public clouds. Hyperion Research applied several assumptions in developing these estimates, based heavily on interviews of end users:

- A public cloud, as we define it, is any large, third-party cloud that sits outside of an organization's firewall and is accessible over the public Internet to anyone (or at least to a large set of organizations) in return for payment.
- The starting estimate was the percent of all HPC workloads that users said they were sending in public clouds. Hyperion Research applied this ratio in the aggregate to users' spending on on-premise servers to create cloud spending estimates for 2013 to 2017 and then cross-checked these estimates with surveyed user budget allocations for clouds, servers and other items. Additional interviews with both CSPs and users provided estimates of the percentage of public cloud workloads that were being paid for, as some first-time users have been able to experiment on public clouds at no cost before committing to paid contracts.
- With those factors, Hyperion Research created an estimate of the percentage of the workloads going to the cloud that are paid for by users.

Historic Spending in Public Clouds

Table 1 and Figure 1 show the historical market size of user spend on HPC in public clouds. The CAGR for the 5-year period is a healthy 25.5%.

Table 1

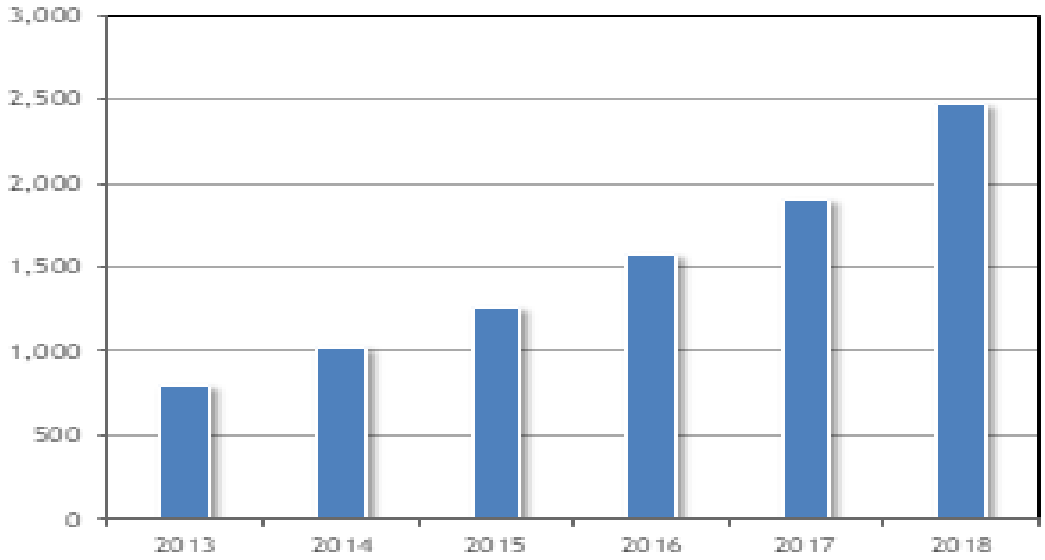
Historical Spending in Public Clouds for HPC Applications

$ M	2013	2014	2015	2016	2017	2018	CAGR 13-18
Total HPC Spending on Public Cloud	791	1,027	1,265	1,581	1,898	2,466	25.5%
Yearly Growth Rate		29.9%	23.2%	24.9%	20.1%	29.9%	

Source: Hyperion Research, 2019

FIGURE 1

Historic Spending in Public Clouds



Source: Hyperion Research, 2019

Projected Spending in Public Clouds

Table 2 and Figure 2 show our projection of the market to 2022. Using historical data, as well as interviews and knowledge of the HPC ecosystem and the direction that the market is heading, Hyperion Research projects the market size to be over $5.5 billion in 2022 with a CAGR for the five-year projection of just under 24%.

Table 2

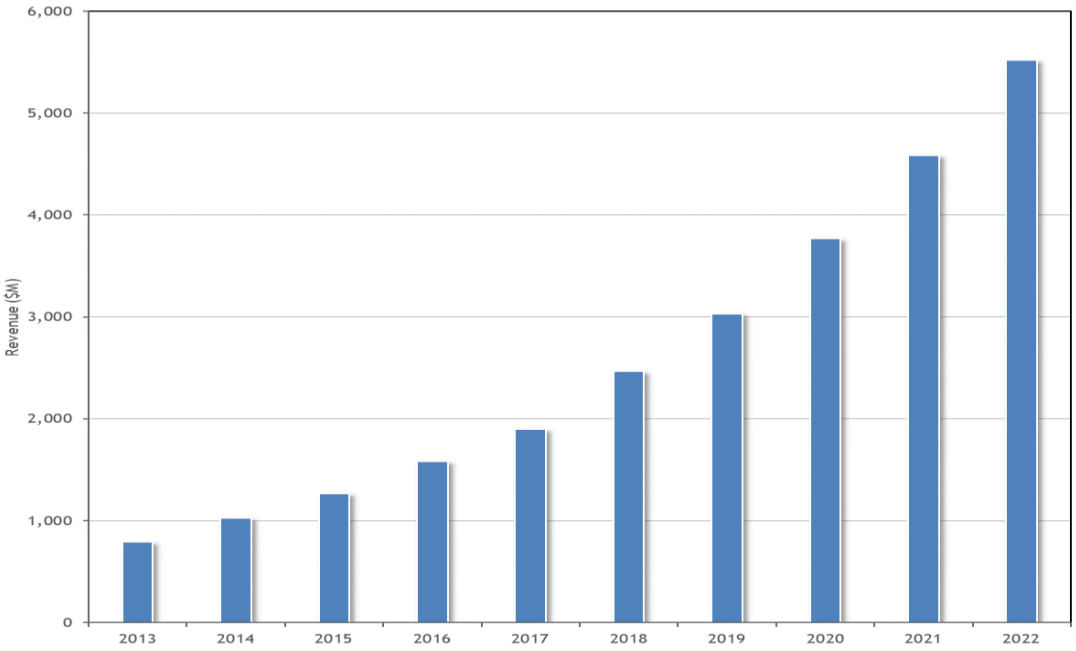
Projected Spending in Public Clouds for HPC Applications

$ M	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	CAGR 17-22
Total HPC Spending on Public Cloud	791	1,027	1,265	1,581	1,898	2,466	3,031	3,771	4,585	5,520	23.8%
Yearly Growth Rate		29.9%	23.2%	24.9%	20.1%	29.9%	22.9%	24.4%	21.6%	20.4%	

Source: Hyperion Research, 2019

FIGURE 2

Projected Spending in Public Clouds for HPC Applications



Source: Hyperion Research, 2019

The Overall HPC Market Including All Types of Spending

Table 3 shows the HPC spending in public clouds as it compares with the HPC server market projection as well as our ecosystem projections. As seen above, public cloud spending is growing more than twice as fast as both the HPC server market as well as the HPC ecosystem as a whole. Note that Table 3 does not roll "total spending on public cloud" into the figure for "entire HPC ecosystem revenue." Table 4 and Figure 3 provide this view.

Table 3

Total HPC Spend on Cloud as Related to Server and Ecosystem

$ M	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	CAGR 17-22
Entire HPC Ecosystem Revenue	21,266	21,037	21,914	23,227	24,274	26,080	27,388	31,053	34,588	38,411	9.6%
HPC Server Revenue	10,299	10,222	10,727	11,595	12,262	12,902	13,510	15,256	16,966	19,557	9.8%

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Source: Hyperion Research, 2019

Table 4 and Figure 3 show the entire HPC ecosystem with the addition of spending in public clouds, projected to 2022. By 2022, including public clouds, the entire revenue of the HPC ecosystem is projected to grow from $26 billion in 2017 to be almost $44 billion, with a strong 10.9% CAGR for 2017-2022.

Table 4

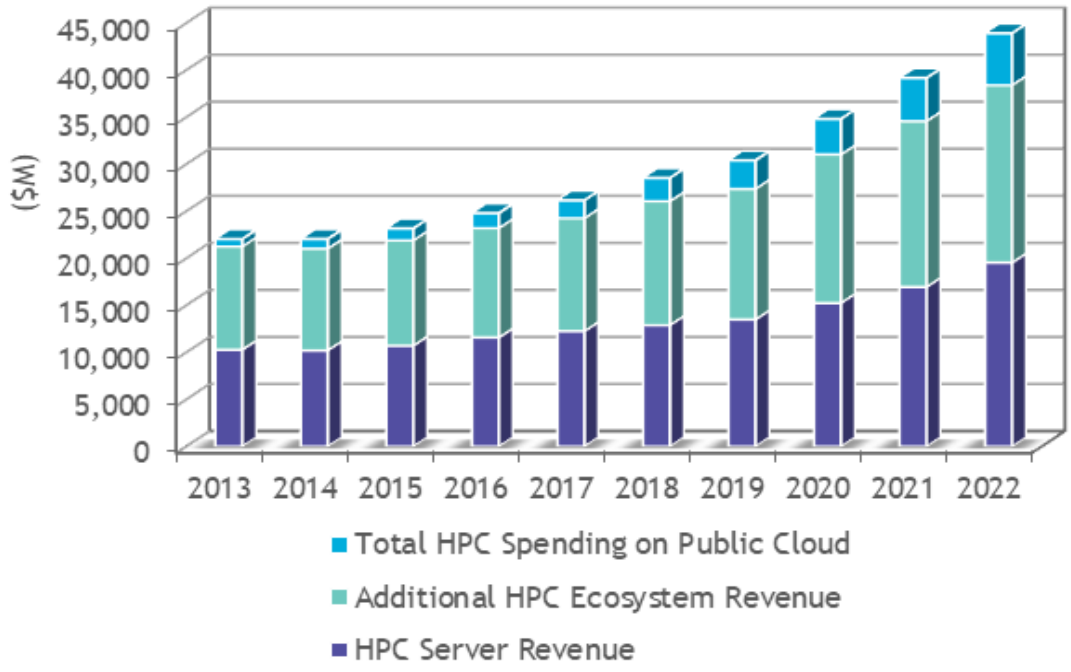
Total HPC Ecosystem Spending, including Public Cloud

$ M	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	CAGR 17-22
Entire HPC Ecosystem Revenue	21,266	21,037	21,914	23,227	24,274	26,080	27,388	31,053	34,588	38,411	9.6%
HPC Server Revenue	10,299	10,222	10,727	11,595	12,262	12,902	13,510	15,256	16,966	19,557	9.8%
Total HPC Spending on Public Cloud	791	1,027	1,265	1,581	1,898	2,466	3,031	3,771	4,585	5,520	23.8%
Total HPC Ecosystem Spend Including Public Cloud	22,057	22,064	23,179	24,807	26,172	28,546	30,419	34,824	39,173	43,930	10.9%

Source: Hyperion Research, 2019

FIGURE 3

Total HPC Ecosystem Spending, including Public Cloud



Source: Hyperion Research, 2019

FUTURE OUTLOOK

The future of HPC spending in public clouds looks bright, as the cloud services providers are working to create a more versatile and high-performance environment for a diverse number of HPC, HPDA and AI workloads.

As edge computing, AI, and 5G evolve in the coming years, public clouds will also play a crucial role in the deployment of the edge computing ecosystem. Some of the most economically important AI use cases, such as automated driving systems and precision medicine, will require closely coupled environments that combine local computing and low-latency communications (e.g., car to car) with higher-latency, cloud-based computing and communications (e.g., urban traffic management).

As public cloud offerings become more versatile, and the cost of movement to the cloud grows more attractive, it will become a more viable and stronger option for more HPC users, from SMBs to large corporations. Hyperion Research expects users from across all segments of the market to run more of their computations in public clouds in the future. Today, Hyperion Research surveys indicate that the greatest hurdles to overcome are the data security and data movement issues/costs, followed by performance issues that lead to weaker price/performance on a number of HPC applications.

APPENDIX: ASSUMPTIONS FOR MARKET SIZE AND FORECASTS

Tables 5 and 6 show the overall forecast assumptions used in developing these forecasts.

Table 5

Top 3 Assumptions for the HPC Public Cloud Spend 2018-2022

Market Force	Hyperion Research Assumption	Significance	Changes to This Assumption That Could Affect Current Forecast	Comments
Economy	Hyperion Research assumes that the global economy will be broadly stable 2018 to 2022. Short-term prospects for the U.S. economy have improved in 2018. In Europe, the economy will also grow at a moderate rate through this period.	Moderate. An up economy improves business and buyer confidence, availability of credit and private investment, and internal funding.	US GDP growth under 2% or over 4%, equivalent for Europe and Japan would require a restatement of the forecast.	Hyperion Research expects the economy to have only a minor impact on the dynamics of the high end of the HPC market. The lower half of the market is more dependent on economic swings.
Exascale Initiatives	Exascale initiatives around the world will continue to increase momentum in the supercomputer segment. Increasing government investments related to exascale will also help grow petascale system sales over the forecast period.	High. Several nations are in the race to develop exascale systems, some of which are likely to exceed $500M per system. This will stimulate global revenue expenditures at the high end of the HPC market.	Hold up or delays of government funding of very large systems. Changes in European and Chinese approaches, to more heavily use new domestic processors, could delay installations.	There will likely be major surprises over the period, resulting in changes in leadership positions. In addition, funding plans that currently exist may not be fully funded.
HPC Leadership	The US has announced major funding and projects for exascale systems. Europe has committed a major increase in funding for HPC. China and Japan will compete heavily for global leadership and will increase funding during the forecast period.	Moderate. Competition in the global high-end HPC market continues to heat up. The Supercomputer segment took a step back from 2013 to 2017 after the major growth spurt in 2012. And is expected to start showing strong growth starting in 2019.	A top high-end HPC system can cost over $500M and in one case could reach $1 billion (US dollars). The deployment or non-deployment of one or two of these systems in a single year, can significantly impact the yearly market.	We expect that more countries will enter the race for HPC leadership, and this could drive growth at the very high end of the HPC market.

Table 5

Top 3 Assumptions for the HPC Public Cloud Spend 2018-2022

Market Force	Hyperion Research Assumption	Significance	Changes to This Assumption That Could Affect Current Forecast	Comments

Source: Hyperion Research, 2019

Table 6

Key Forecast Assumptions for User Public Cloud HPC Spending, 2018-2022

Market Force	Assumption	Impact	Accelerator/ Inhibitor/ Neutral	Certainty of Assumption
Macroeconomic Trends				
Economy	Hyperion Research assumes that the global economy will be broadly stable 2018 to 2022. Short-term prospects for the U.S. economy have improved in 2018. In Europe, the economy will also grow at a moderate rate in this period.	Moderate. A down economy affects business and consumer confidence, the availability of credit and private investment, and internal funding.	Neutral	3
Wild Cards	The stability of the EU with BREXIT could change things. The impact of new processor types (domestic designs, new types of accelerators, FPGAs, AI centric processors, etc.) could dramatically change system designs and competitive positions.	Moderate. Wild card events such as a collapse of the eurozone or conflict in Iran have the potential to significantly impact global growth. Even emerging markets could be vulnerable to a major crisis.	Inhibitor	3
Cloud Services	Clouds are a fast-growing new paradigm of computing that will shape broader IT spending over the next several decades. It entails shared access to virtualized resources over the Internet. Private and public cloud computing is ramping up in HPC.	High. The key advantage to cloud services should be the ability of IT organizations to shift IT resources from maintenance to new initiatives. There is also a strong push from executives at companies to evaluate the cloud as a viable alternative, which	Accelerator	4

Table 6

Key Forecast Assumptions for User Public Cloud HPC Spending, 2018-2022

Market Force	Assumption	Impact	Accelerator/ Inhibitor/ Neutral	Certainty of Assumption
		should accelerate the adoption.		
Software Industry Transformation	The software industry is going through a major transformation, from basic architecture (service-oriented architecture [SOA]) and the way software is written (composite applications) to the way software is delivered (software as a service [SaaS]) and even funded (advertising based).	Moderate. The new software creation and delivery models should allow for a quantum increase in the ability to deliver and integrate new software functionality into ICT systems. This should increase overall spending even as it lowers costs.	Accelerator	4
Application Availability	ISVs lag in developing multithreaded applications to take advantage of multicore processors.	Moderate. As opensource becomes even more widespread and the ISV porting to the cloud grows, the availability of applications will increase.	Accelerator	4
Worldwide Hardware Server Markets	The overall server market saw explosive growth starting in 4Q 2017 through 2Q 2018, driven heavily by the growth and upgrading of large public clouds. On-prem servers also are seeing healthy growth, but at a much lower rate.	High. Hardware spending, about 40% of total IT spending, also drives spending in software and services.	Accelerator	4
Overall HPC Market Trends				
Economic Impacts on HPC	The recovery of the global economy will continue to have a positive impact on overall IT markets, IT server spending, and HPC server spending.	High. HPC server sales will expected to continue to grow at an underlying rate of 6% to 8%, with many ups and downs. 2022 is expected to be a high point, with many very large exascale systems being sold that year. Pent-up demand at the low-end should fuel growth as the global economy rebounds.	Accelerator	4
High-End HPC Supercomputer Sector	The high-end "supercomputer" segment will become a bright spot as the petascale/exascale race	Moderate. This "lumpy" segment will remain subject to major swings on a quarter-to-	Accelerator	4

Table 6

Key Forecast Assumptions for User Public Cloud HPC Spending, 2018-2022

Market Force	Assumption	Impact	Accelerator/ Inhibitor/ Neutral	Certainty of Assumption
	intensifies across the globe. Funding will likely continue to increase for large scale HPC procurements.	quarter basis due to the relatively small number of large transactions that occur in this segment.		
Mainstream Midrange HPC Market	The mid-range HPC market revenue profile will see healthy growth in the forecast period as macroeconomic conditions improve.	Moderate. The mid-range HPC market has shown continuous year over year growth in the past 4 years, indicating that this market segment is stronger than before and will continue to grow.	Accelerator	4
Mainstream Low-End HPC Market	The low-end HPC market resumed revenue growth in 2013 through 2017. During the forecast period as macroeconomic condition improves, discretionary budgets will slowly come back, and the low-end market will expand again at a healthy rate.	High. We expect CAGR during the forecast period to be on the order of 6% to 7%, and higher than the mid-range market.	Accelerator	4
HPC Sales in Government and Academic Sectors	Government and university HPC purchasing will remain a bright spot in HPC during the recovery period.	Moderate. Government and university HPC purchases have longer sales cycles and budgets change more slowly, so the impact will not be consistent from quarter to quarter. One or two very large system sales can affect revenue for a given year.	Accelerator	4
National Security and Homeland Defense	National security and homeland defense operations will continue to develop additional requirements for HPC systems. New applications areas for HPC may be developed based on database and pattern matching requirements.	High. Requirements will lead to increased demand through the forecast period.	Accelerator	3
Energy Sectors	The worldwide demand for oil has picked up with the economy recovery and with the expanding economies of China and the other BRICs. This increased demand will help spur sales for systems for seismic analysis and reservoir modeling,	High. R&D for alternative energy sources, nuclear, coal, and in oil/gas are expected to be strong growth segments.	Accelerator	4

Table 6

Key Forecast Assumptions for User Public Cloud HPC Spending, 2018-2022

Market Force	Assumption	Impact	Accelerator/ Inhibitor/ Neutral	Certainty of Assumption
	along with HPC systems for alternative energy sources.			
Gaming, Digital Content and Entertainment Sectors	The use of HPC to create better large-scale games, digital content, animations, and more interesting videos/movies is expected to grow at a healthy rate.	Moderate. This will lead to an increase in demand for technical servers.	Accelerator	3
Automotive Segment	With automated driving becoming a priority for many companies, HPC procurements are using HPC more now than in past years, not only for car design but for deep learning models for automated driving.	Moderate. The automotive industry is creating strategies for employing HPC, especially using AI/ML/DL to create new types of cars.	Accelerator	3
Worldwide Finance Segment	Hyperion Research foresees increased investment in HPC, especially to support new high frequency trading (HFT) algorithms. HPDA and AI, ML & DL applications will cause strong growth.	High. Many new HPC procurements will be used for running new algorithms faster and more accurately.	Accelerator	3
HPC Technology Trends				
Exascale Initiatives	Exascale initiatives around the world will continue to increase momentum in Hyperion Research's Supercomputer segment.	High. A number of nations are in the race to develop petascale and exascale systems, some of which already are expected to cost over $500M per system. This will help stimulate global revenue expenditures at the high end of the HPC market.	Accelerator	4
New Processors	Hyperion Research expects x86 base processors to remain dominant during this period, but with a growing set of new processors from Europe, China and Japan. Co-processors and accelerators, especially NVIDIA GPGPUs, will see increased traction in the forecast period. Low-power processors, especially ARM-based	High. New processors, co-processors and accelerators are rapidly gaining momentum in the HPC community today and the mainstream adoption is largely dependent on the programming models and application readiness.	Accelerator	5

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Key Forecast Assumptions for User Public Cloud HPC Spending, 2018-2022

Market Force	Assumption	Impact	Accelerator/ Inhibitor/ Neutral	Certainty of Assumption
	designs, will begin finding their place in the HPC ecosystem.			
High Performance Data Analysis (Big Data Needing HPC)	Data Intensive computing has long been a part of HPC but newer analytical methods using Hadoop and other methods (e.g., learning models, graph analytics) will grow the Big Data-AI market in HPC. In addition, the data explosion in HPC will drive larger system and storage purchases. In the long term, Big Data will shift HPC architectures away from their current extreme compute centrism.	High. We expect most buyers to purchase the same systems for traditional HPC and newer Big Data in the short run, but in 2-3 years more users will buy separate HPDA-AI systems with more data-friendly designs. The ultimate goal is for dynamically reconfigurable systems that can do both things well.	Accelerator	4
Cloud Friendliness to HPC Applications	As public clouds have evolved, they are becoming a better fit for more HPC applications. As clouds continue to become friendlier to HPC applications, more HPC users will move larger workloads to public clouds.	High. As more applications become efficient on the cloud, Hyperion Research expects there to be a few "tipping points" where the market will grow significantly due to a sudden influx of workloads on public clouds.	Accelerator	
AI Along with Machine Learning and Deep Learning	AI, along with ML and DL, is an area of the market that is growing extremely fast. As AI solutions are starting to become available for many sectors, as well as the push to new hardware and software environments, Hyperion expects this to be an influential new market.	High. AI, including ML and DL, is penetrating many verticals with a strong push from users to further the development of the AI ecosystem.	Accelerator	4
HPC Leadership	Europe has already committed a major increase in funding for HPC. China and Japan will compete heavily for global leadership and will increase funding during the forecast period. The US has stepped up in their recent procurement cycle to keep pace with other countries.	High. Governments around the world are increasingly recognizing the importance of HPC not only for scientific advances but also for industrial innovation and economic competitiveness.	Accelerator	5

Source: Hyperion Research, 2019

About Hyperion Research, LLC

Hyperion Research provides data-driven research, analysis and recommendations for technologies, applications, and markets in high performance computing and emerging technology areas to help organizations worldwide make effective decisions and seize growth opportunities. Research includes market sizing and forecasting, share tracking, segmentation, technology and related trend analysis, and both user & vendor analysis for multi-user technical server technology used for HPC and HPDA (high performance data analysis). We provide thought leadership and practical guidance for users, vendors and other members of the HPC community by focusing on key market and technology trends across government, industry, commerce, and academia.

Headquarters

365 Summit Avenue
St. Paul, MN 55102
USA
612.812.5798
www.HyperionResearch.com and www.hpcuserforum.com
