Hewlett Packard Enterprise

Statement of Andrew Wheeler, HPE Fellow, Vice President and Director of Hewlett Packard Labs at Hewlett Packard Enterprise before the Senate Committee on Energy and Natural Resources

Hearing to examine recent advances in artificial intelligence and the Department of Energy's role in ensuring United States competitiveness and security in emerging technologies

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Chairman Manchin, Ranking Member Barrasso, and distinguished members of the committee, thank you for the opportunity to testify today. It is an honor to be here to discuss the importance of recent advances in artificial intelligence and the Department of Energy's mission to strengthen national security and competitiveness through cutting-edge technologies.

My name is Andrew Wheeler and I am Vice President and Director of Hewlett Packard Labs, the central applied research group for Hewlett Packard Enterprise that was established in 1966 by the founding company, which is widely recognized as the birthplace of Silicon Valley. As many of you know, Hewlett Packard Enterprise was formed as a new publicly traded company in November 2015. We have a rich, decades-long history of co-developing leadership computing with the U.S. government.

My testimony will highlight the role of U.S. public-private partnerships in co-designing and co-developing the next-generation supercomputing systems that are vital to unlocking value from AI and maintaining leadership in this critical technology.

Hewlett Packard Enterprise partners closely with U.S. federal agencies on R&D projects. Our work has advanced and achieved state-of-the-art capabilities for a range of technologies, including areas that are critical to increasing performance, speed, security, and productivity for growing data-intensive applications, such as AI, and that are driving demand for more computing and network bandwidth resources. These technologies include high-speed networking, silicon design for advanced high-performance computing and supercomputing, and neuromorphic computing.

I am currently directing research and advanced development efforts for emerging technologies, including trustworthy AI, quantum computing, security, silicon photonics, and systems architecture, among other initiatives.

In addition to overseeing our Labs, I also lead our High-Performance Computing (HPC) and Artificial Intelligence (AI) Advanced Development and Chief Technology Office organizations to fuel future innovations that can be leveraged across our company. Our Labs team and the HPC & AI Advanced Development organization collaborate with the U.S. government and its national laboratories, academia, and industry partners to deliver innovation that propels our growth as a nation and as a society.

HPE's world-leading supercomputers support the nation's mission-critical initiatives

HPE's expertise is deeply rooted in computing. We design trusted systems from the ground up to deliver powerful technology. For decades, we have influenced the design and engineering of the world's leading semiconductor chips to deliver significant advancements in performance and capabilities for emerging applications.

We are the leading expert in supercomputing, delivering the world's most powerful systems. Bolstered by HPE's acquisition of Silicon Graphics and Cray, a pioneer in supercomputing, we provide world-leading supercomputers that continue to demonstrate significant value in accelerating scientific discovery and enabling new techniques in engineering.

For decades, HPE has worked closely with the Department of Energy to jointly design, develop, and engineer many world-first achievements in supercomputing. Most recently, together with the Department of Energy, HPE built the first U.S. exascale systems – "Frontier" at Oak Ridge, "Aurora" at Argonne, and "El Capitan" at Lawrence Livermore for the National Nuclear Security Administration (NNSA) to advance R&D for the nation's nuclear deterrent.

With our partners at the DoE, we co-design and co-build supercomputers that target complex scientific, engineering, and data-intensive workloads for U.S. national laboratories and R&D centers across the Department. These include Sandia and Los Alamos National Laboratories in New Mexico, National Renewal Energy Laboratory (NREL) in Colorado, and National Energy Technology Laboratory (NETL) in Morgantown, West Virginia.

The investments in supercomputing made by the DoE have far reaching benefits across the federal government. For example, the innovations in computing power and capabilities that we provide to the DOE are being used by the Department of Defense and the intelligence community, including the Stennis Space Center Mississippi for the U.S. Navy, MIT Lincoln Laboratory in Massachusetts, and the Army and Air Force labs to advance defense missions.

Our supercomputers are used to power the nation's weather forecasting, including predicting catastrophic events. The National Oceanic Atmospheric Administration (NOAA) has adopted our supercomputers in its labs and research centers in Phoenix, Arizona, Virginia, and Fairmont, West Virginia.

HPE-built supercomputers can be found in labs and research centers sponsored by the National Science Foundation, such as the National Center for Atmospheric Research (NCAR) in Wyoming, the National Center for Supercomputing Applications (NCSA) in Illinois, Stony Brook University in New York, and the Pittsburgh Supercomputing Center in Pennsylvania.

Using supercomputing to increase U.S. industry competitiveness with faster time-to-market innovation

Additionally, supercomputers are impactful to R&D and product design across the commercial sector, contributing to our nation's competitiveness. HPE works closely with leading U.S. companies in advanced manufacturing, energy, aerospace, transportation, health care, automotive, and pharmaceuticals to deliver advanced supercomputing to accelerate U.S. innovation in the market.

According to a study by Hyperion Research, an industry analyst firm that examines the high-performance computing and supercomputing industry, supercomputers have contributed to product innovation, such as automotive, aircraft, and pharmaceuticals, that are valued at more than $100

trillion over the last 25 years. Hyperion also estimates that the economic value created by applications running on supercomputers has exceeded $3 trillion over the past 25 years.

Hyperion conducted a study on 175 industrial firms and found that on average, companies realized $452 for every $1 they invested in HPC and estimated that 175 HPC-supported projects created 2,335 new jobs.

Realizing transformative benefits of AI with supercomputing

At HPE, we fundamentally believe that AI will usher in a new wave of productivity and have as significant an impact as the advent of mobile, cloud, and Web 2.0. AI will equip Americans with better tools to automate, analyze, and solve problems faster. Making breakthroughs in scientific research and development will strengthen our national security, increase our competitiveness, and help maintain American leadership.

Given the massive, specialized computing performance and scale that supercomputers deliver, these systems are ideally suited to efficiently train AI models and run AI applications. By applying artificial intelligence to research conducted on supercomputers, scientists and engineers can further their research and accelerate discoveries.

For example, during the early stages of the COVID-19 outbreak, the national labs, including Argonne and Lawrence Livermore, used their supercomputers to accelerate a path to treatment to combat the disease.

Researchers used AI on detailed, digital simulations of molecular interactions between the virus' spike protein and a vast data set of drug candidates. Researchers at Lawrence Livermore National Laboratory found this approach to be incredible – narrowing down the number of potential antibody candidates from an initial set of 100 duodecillion – that's a 1 with 40 zeros after it – to just 20. The lab's researchers also accomplished this in weeks, compared to the years it would take using other approaches.

The U.S. ushers in the fastest computing made possible today with exascale

In 2016, to maintain leadership in science and technology, and advance our nation's position in AI, the Department of Energy sought to break barriers in computing speed and usher in a new era of supercomputing by forming the Exascale Computing Initiative (ECI). The initiative was formed within the Department of Energy, as a partnership between two DOE organizations: the Office of Science (SC) and the National Nuclear Security Administration (NNSA).

HPE was proud to be a key partner for the ECI, which was designed to accelerate the research, development, acquisition, and deployment of new technologies to deliver exascale computing, and to usher in a new era of supercomputing speed and capabilities. The exascale threshold delivers up to 10X faster performance than most of the world's most powerful supercomputers and offers insights and the ability to solve complex problems that were previously impossible.

As part of the ECI, a program called PathForward was introduced that granted $258 million across select U.S. technology companies, including HPE and Cray. The grants allowed us to design and build a completely new supercomputing architecture from the ground up that can scale to an unprecedented speed while consuming significantly lower power.

The resulting solution -- the HPE Cray EX supercomputer – was selected as the supercomputing platform for U.S. exascale systems. The HPE Cray EX supercomputer is designed with end-to-end,

cutting-edge technologies spanning CPUs, GPUs, unique Ethernet capabilities that can scale to tens of thousands of GPUs, software, and sophisticated closed-loop liquid cooling capabilities.

Then in May 2022, HPE ushered in exascale computing with Frontier, which represents an increase of nearly 70,000-fold over the past 20 years. This was a pinnacle moment in supercomputing that restored the U.S. position as having the world's most powerful supercomputer. The massive achievement also demonstrated the essential role of public-private partnerships in advancing national technological priorities.

Since its debut last year, Frontier has already helped scientists make breakthroughs in aerospace, medicine, and nuclear physics. Frontier is also the world's largest AI system, bringing nearly 40,000 GPUs to task to build and train large-scale AI models, improve model accuracy, and accelerate outcomes. Those technologies are being adopted by other U.S. national laboratories and across federal agencies, including Los Alamos National Laboratory, National Oceanic Atmospheric Administration (NOAA), National Renewable Energy Laboratory (NREL), National Energy Research Scientific Center (NERSC) at Lawrence Berkeley Lab, and the National Center for Atmospheric Research (NCAR), the Department of Defense, National Aeronautics and Space Administration (NASA), National Institutes of Health (NIH), and the Department of Interior.

Realizing the full potential of AI with advancing computing

In a DOE-led published report, "AI For Science," the DOE details opportunities for applying new AI techniques to 16 application areas, including science, energy, security, facilities, and other areas, that when advanced with AI, have the potential to transform the department's research capabilities.

The report identifies six broadly applicable AI building blocks to target a range of use cases, including fusion energy, nuclear deterrence, bio assurance, advanced manufacturing, drug discovery, digital twin modeling for complex scientific domains, and personalized medicine.

To successfully execute these AI approaches and advance the DOE's national missions, we need to continue investing in advancing computing environments to support large-scale AI models.

AI model sizes have significantly grown over the years, requiring more computing resources. When training AI using a volume of complex data, it is critical that we provide the computing environment to do so efficiently if we want to realize the full potential of AI to solve problems.

With a higher requirement level of computing, requiring the capacity to run many GPUs, or accelerators, at once, commodity servers and the traditional public cloud are neither an efficient nor sufficient solution.

Building on exascale innovation to accelerate AI initiatives

By building on U.S. exascale leadership, the Department of Energy is exploring initiatives to leverage today's most powerful supercomputing technologies to support the DoE's AI mission and missions across disciplines throughout the federal government.

Just as it set out to build the world's most powerful supercomputer with exascale, the DoE aims to continue to build the world's most powerful AI systems and foundational models to target scientific research use cases across materials science, particle physics, molecular biology, chemistry, and environmental sciences.

We believe that this is an important initiative to accelerate our nation's mission of advancing AI at a larger scale and are working closely with the DOE and its national laboratories to enable this capability.

A recent study published by the National Academies, "Charting a Path in a Shifting Technical and Geopolitical Landscape," underscores the need for the DOE to achieve its goals. The study reinforces that exascale computing will allow the National Nuclear Security Administration (NNSA) to take full advantage of new computational approaches, but that we need to sustain investments in supercomputing if we want to continue to foster that innovation.

Continuing strong national investment in supercomputing to fuel AI and maintain leadership

In conclusion, while the United States has regained its rightful role as the world leader in supercomputing, now is not the time to rest on our laurels if we want to maintain that position. The DoE national labs are producing the types of results, harnessed from complex research, and speed of innovation that researchers could have only dreamed of just a few years ago. Continued investment in this success is in our national economic and security interests and HPE looks forward to working with the U.S. government to continue this legacy of global leadership.