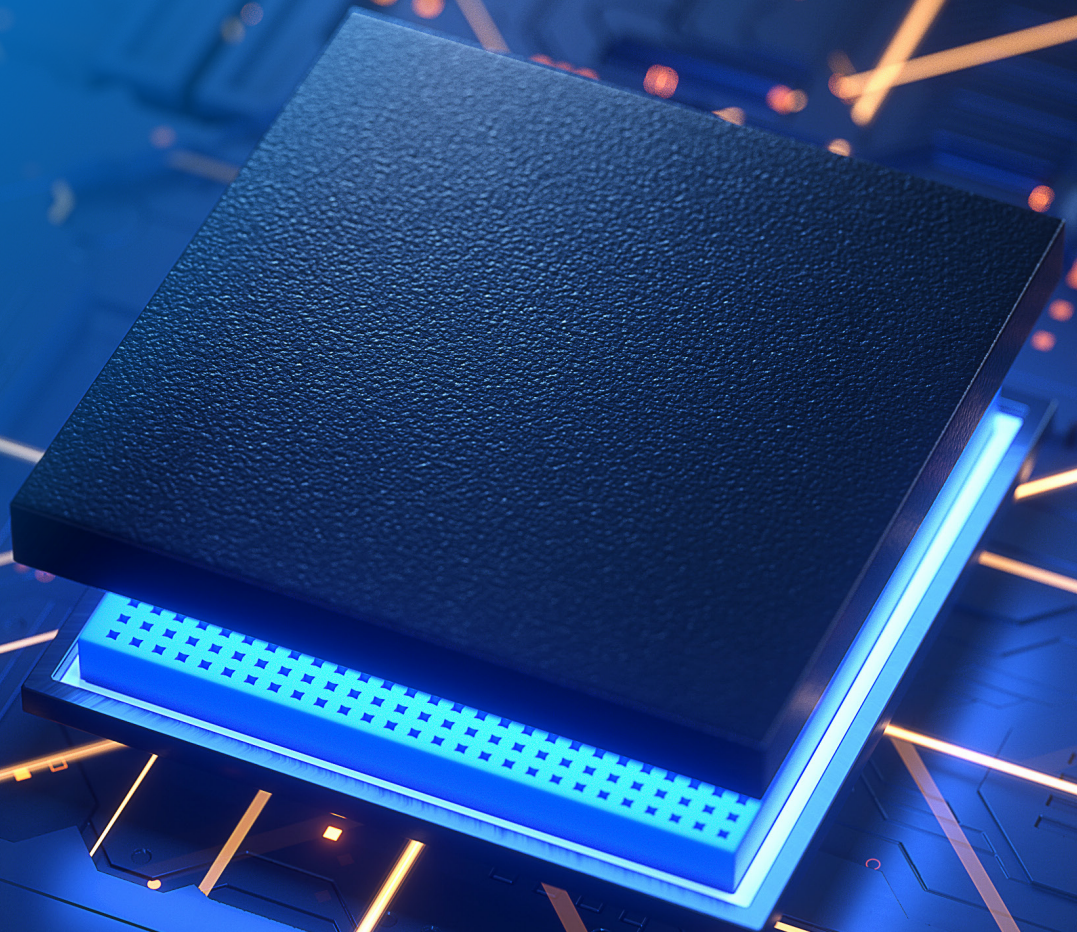


DELLTechnologies

Shaping the future of semiconductor design and manufacturing

How a modern infrastructure can
help electronics manufacturers
innovate faster with lower risk
and cost





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Semiconductors are invisible orchestrators driving innovation across virtually every industry

From the smartphones in our hands to the big data centers powering the internet, from self-driving cars to robotic surgical systems — inside each is a tiny piece of technology that makes it all possible: a semiconductor.

Semiconductor chips are the building blocks of modern electronics and the essential technology enablers that power many of the electronic devices we use today. The proliferation of cutting-edge devices such as smartphones, electric cars, smart home devices, and wearables drives a constant expansion of the number of semiconductor components we use in our daily lives.

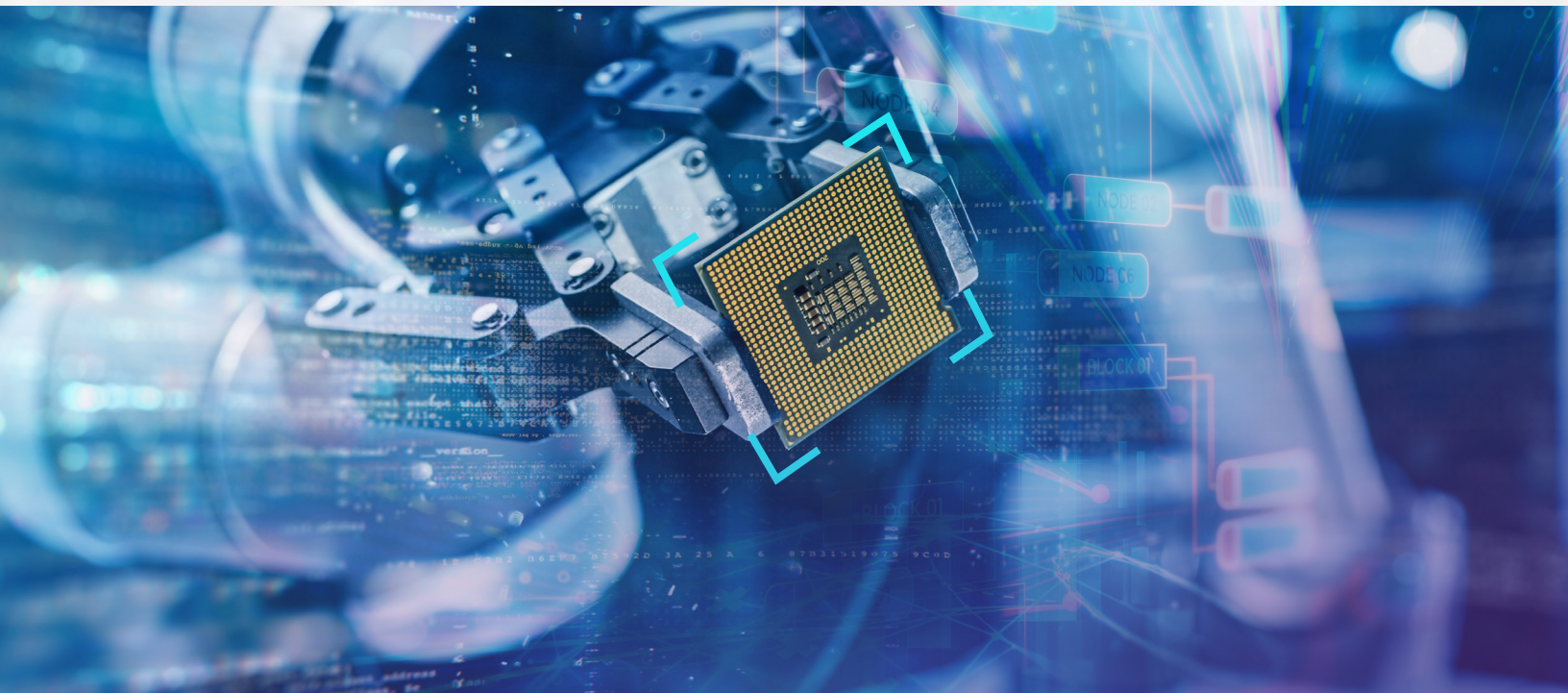
The evolution of semiconductors

The manufacturing of transistors from silicon allowed them to become small enough to fit on a microchip, paving the way for a rush of gadgets that have become smaller and smarter over the years at an unprecedented pace. Gordon Moore, the co-founder of Intel and Fairchild Semiconductor, predicted that the number of transistors that could fit per square inch on a computer chip would double every two years. In other words, electronic devices would double in speed and capability about every two years. And indeed, every year, technology companies create new gadgets that are faster, smarter, and better. Over the past decade, the need for leading-edge technology leadership has transformed from an amorphous goal to an absolute necessity.

Design complexity is driving the growth of data

Over the decades, transistors have become smaller and smaller, and semiconductor design complexity has become larger and larger. As each generation of designs became more complex and denser, the total storage required grew exponentially. A semiconductor design project that previously required hundreds of terabytes can now require tens of petabytes of data. Throughout the design phase, massive amounts of data are created and analyzed from files of varying sizes and types. These ever-growing, data-intensive workloads often place the underlying infrastructure under tremendous stress, forcing unprecedented growth in essential IT resources such as compute, networking, and storage. As this growth continued, architectural weaknesses in the underlying IT infrastructure were exposed. A decade ago, CPU performance was a barrier, and the industry relied more on concurrent processes and CPUs with more cores. As total cores grew, the bottleneck shifted to storage.

Today, storage challenges continue to get more difficult with each new chip design – posing a real threat to achieving the desired time-to-market. Scale-up storage, which has been the popular choice of semiconductor design for over a decade, struggles to deliver performance at scale as concurrent job quantities grow. In addition, scale-up storage, which relies on individually managed controllers, each with separately managed shelves of disk drives, creates islands of storage that are a challenge to manage. This drives up cost and hampers a company's ability to tune performance, which ultimately impacts time-to-market. These challenges and others have led to the rise of a new storage-architecture, scale-out, which has proven better suited for time-sensitive, semiconductor design workloads.



Addressing the data challenges of semiconductor design and manufacturing

Dell EMC PowerScale

Bring predictability to semiconductor design tool performance at scale



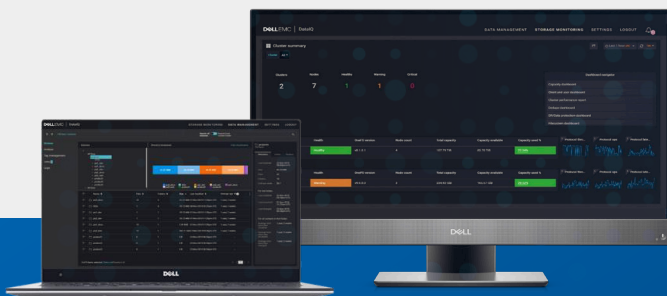
Dell EMC ECS

Manage your IP portfolio



Dell EMC DataIQ

Take control of project data



Dell EMC Streaming Data Platform

Realize the full potential of smart manufacturing



Predictable semiconductor design tool performance at scale

Dell Technologies has set a new standard for unlocking the potential of semiconductor design tool performance with Dell EMC PowerScale storage. The PowerScale family, with scale-out architecture, enables organizations to unlock their engineering teams' potential, no matter where their design data resides. The PowerScale family, which includes PowerScale platforms and Isilon platforms powered by the PowerScale OneFS operating system, represents a flexible NAS solution that is simple to install and manage – and scales to meet the ever-growing demands of semiconductor design.

PowerScale eliminates storage performance bottlenecks, reducing runtimes for concurrent semiconductor design jobs. Its performance scales linearly with capacity: bringing scheduling predictability, improving storage efficiency to lower capital expenditures, centralizing management to reduce operating expenses, and delivering strategic advantages to reduce a chip's time-to-market.

Massive scalability

PowerScale's native scale-out architecture means semiconductor companies don't have to compromise on features or performance, which grows linearly even as capacity grows from tens of terabytes to tens of petabytes.

Extreme performance at scale

PowerScale consistently delivers high performance even as concurrent jobs grow to hundreds of thousands or more. PowerScale All-flash models are ideal for IOPS-intensive semiconductor workloads such as logic synthesis, gate-level simulation, full-chip verification, and software builds.

Low TCO

With average disk utilization greater than 80%, PowerScale is one of the most efficient, cost-effective storage solutions available for the semiconductor industry today. And with available compression, in-line dedupe and auto-tiering, PowerScale can deliver even more savings.

Predictability

A scale-out architecture makes it possible for PowerScale performance to remain consistent as concurrent jobs grow from thousands to millions. A single PowerScale cluster can start small and grow to multi-petabyte scale without reducing cluster performance. Seamlessly add new storage nodes to existing clusters in about 60 seconds with no downtime to keep schedules on-track.

Ease of use and manageability

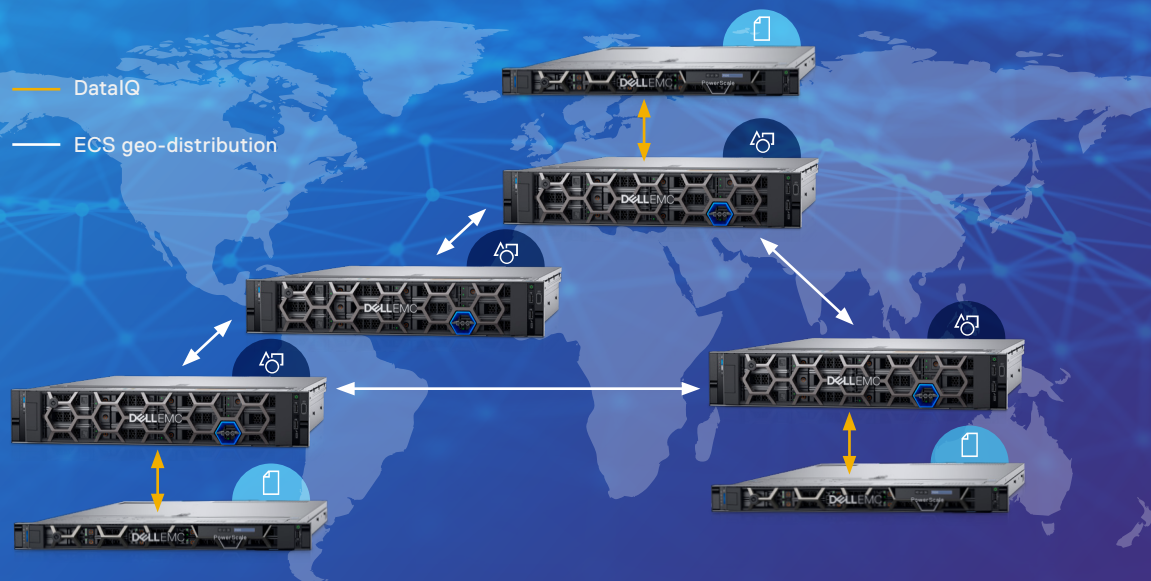
PowerScale makes managing petabytes of semiconductor design data a trivial task. Its scale-out architecture, combined with robust management tools, eliminates most of the traditional management challenges introduced by legacy scale-up storage, including managing hundreds of isolated storage volumes and hidden islands of wasted storage space.

Manage your IP portfolio with ease

As IP portfolios grow in size, today's most successful semiconductor companies are increasingly leveraging object storage systems for long term design data archiving. For those companies that manage multiple, geographically disparate manufacturing lines, the convenience of S3 object protocol support adds to the benefits of object storage. Dell EMC ECS is an enterprise-ready object storage platform that enables semiconductor companies to simplify their global, long-term data management.

Simplify long-term IP management while providing global access

Semiconductor design and manufacturing companies are globally distributed with their design houses and data centers around the world. Dell EMC ECS, companies can manage a globally distributed infrastructure under a single global namespace that provides consistent access. Dell EMC PowerScale CloudPools software provides policy-based automated tiering that seamlessly integrates with the cloud as an additional storage tier. This allows rapid data growth and optimizes data center storage resources by using the cloud as a highly economical storage tier with massive storage capacity for "cold" or "frozen" data that is rarely accessed.



Do more with your design data

Gain manufacturing insights by enabling globally distributed AI/analytics regardless of scale at the economics of object storage.

Build next-gen design flow

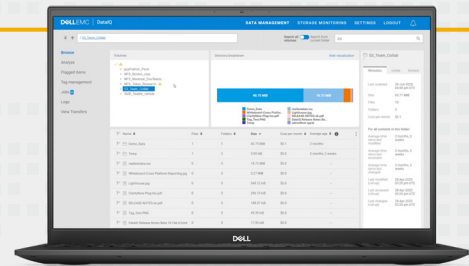
From modern app development to deep archives, semiconductor companies can leverage the versatility and scale of ECS on-prem or in the cloud.

Take control of your project data

Dell EMC DataIQ is a data management and storage monitoring solution that empowers semiconductor companies to identify, classify, and move data between heterogeneous storage systems and the cloud. With a unified file system view, DataIQ allows users to have self-service capabilities to move data on-demand regardless of where it is stored physically. DataIQ delivers unique insights into data usage and storage system health while auditing and tracking ensures design data remains safe.

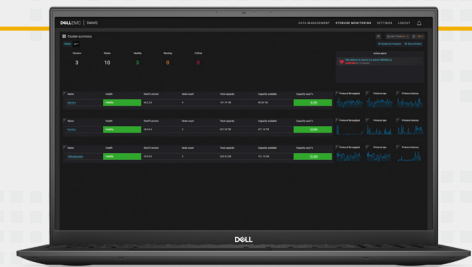
Discover

Locate data and monitor the health of storage infrastructure via a single unified tool.



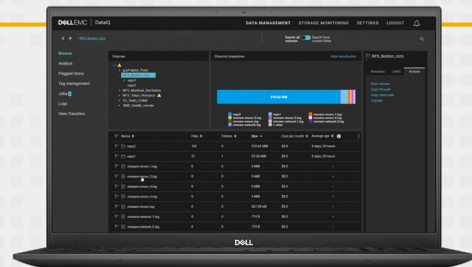
Understand

Gain deep insights into data characteristics, classify it with customizable tags and perform advanced system analysis.



Act

Make more informed decisions, forecast future needs and move data to the optimal storage platform on-demand.



Realize the full potential of smart manufacturing

Semiconductor companies are adopting smart manufacturing to accelerate business success, improve efficiency, and enhance productivity.

Dell EMC Streaming Data Platform empowers semiconductor manufacturing companies to harness their real-time and historical data in a single, auto-scaling infrastructure and programming model. With Streaming Data Platform, all data is ingested into one engine and transformed into unified streams for easy implementation, management, and application development. With auto-tiering storage and unlimited retention, the same paradigm can be used to access both real-time and historical events stored in the platform for simultaneous analysis for deep insights. Manufacturing companies can use these deep insights to make more informed decisions and improve capabilities, such as fault detection and predictive maintenance. This allows manufacturers to lower cost, improve quality and yield, and eliminate unexpected downtime.



Addressing the emerging trends in semiconductor design and manufacturing

Semiconductor companies face a myriad of complexities that demand an ever-accelerating state of operational agility. For most semiconductor companies, gone are the days of lengthy design lifecycles. With growing design complexity and competitive pressures, designers seek innovative solutions to meet consumer demand for higher-performing devices with greater functionality. Likewise, manufacturers facing ever increasing capital investments are adopting new technologies such as Cloud and AI to achieve higher levels of operational excellence.

Cloud



Artificial Intelligence



Cloud

To boost productivity, reduce time-to-market, speed innovation, and lower operating costs, semiconductor companies are turning to the cloud.

Dell Technologies Cloud Storage for Multi-Cloud

Delivers scalable, resilient cloud-attached storage with flexible multi-cloud access

With Dell Technologies Cloud Storage for Multi-cloud, you can rest assured that your design data is secured, protected, available where and when you need it, delivered at the performance levels required by your semiconductor design applications, and in compliance with your company policies. The flexibility of our offering allows organizations to optimize costs while taking control of their data. This multi-cloud solution accommodates the right combination of storage and compute in the cloud for data-intensive, high I/O throughput semiconductor design workloads that require high periodic compute performance.

Dell EMC PowerScale for Google Cloud

Brings game-changing file performance at scale

- Up to 97MBps/TiB of throughput
- Up to 1000 TiBs of aggregate throughput
- Sub-millisecond latency access to Google Cloud

PowerScale for Google Cloud can deliver up to 46x higher maximum read throughput and up to 96x higher maximum write throughput versus the fastest currently available, Google-native, competing high performance NAS solution. With scale-out capacity up to 50PiB in a single namespace on Google Cloud, PowerScale delivers up to 500x higher file system capacity versus the largest, currently available cloud-native high-performance NAS alternative.

¹ Based on a May 2020 ESG Report commissioned by Dell EMC, "Performance Testing of Dell Technologies Cloud OneFS for Google Cloud"

Artificial Intelligence

As design complexity grows, design verification grows exponentially. With time-to-market so critical in the semiconductor industry, companies seek technologies that can improve productivity and achieve their goals in fewer iterative steps.

Artificial Intelligence (AI) provides a unique opportunity for semiconductor companies to accelerate the pace of chip design. AI has the potential to enable design tools to work smarter, leading design teams to tapeout faster.

Dell EMC PowerScale

Delivers the performance needed for high-throughput AI workloads.

PowerScale is the ideal storage complement to GPU accelerated compute for AI workloads.

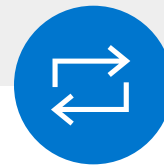
It effectively compresses the time needed for training and testing analytical models for multi-petabyte data sets. PowerScale enables semiconductor companies to process more training data in less time, ultimately improving algorithm development and manufacturing quality and predictability. Each run of the chip produces billions of data points that are available for analysis. With PowerScale's in-place analytics— which leverages multi-protocol support such as SMB, NFS, HTTP, and native HDFS— semiconductor design companies can collect data around those chips to produce better quality chips, faster.



Low
latency



High
throughput



Massively
parallel I/O

Pre-designed and pre-validated Ready Solution for AI

Semiconductor design and manufacturing organizations can accelerate their AI initiative deployments with our pre-designed, pre-validated PowerScale Ready Solution for AI. This proven solution combined with our expertise help organizations lower risk, shorten deployment, and achieve unprecedented performance for AI modeling at scale.

Dell Technologies innovations: Speeding up semiconductor design tool throughput with Storage-Aware Grid Acceleration

The job scheduler is a key infrastructure component of virtually every high-performance computing (HPC) environment - including all semiconductor design tool workflows. Historically, the job scheduler's task was simple: assign batches of jobs to available compute resources to maximize CPU throughput. With an endless supply of inexpensive cores, semiconductor throughput today is limited by storage. Storage-aware Grid Acceleration (SAGA) manages compute, networking and storage holistically - scheduling semiconductor design jobs to maximize throughput at the data center level.

“Having a true scale-out storage system like **Dell EMC PowerScale** with an extensive API stack is invaluable.”

Storage-aware Grid Acceleration and API-level PowerScale integration are key to reducing turn-around time.

Storage-Aware Grid Acceleration (SAGA) is an elegant job scheduler innovation that addressed the next wave of design challenges for semiconductor companies. With SAGA and PowerScale, companies can dynamically distribute jobs based on each job's storage I/O profile, performance and capacity requirements. In addition to a significant throughput gain and reduced turnaround time (TaT), SAGA together with PowerScale and Altair can reduce the total semiconductor licenses and cores required in the compute farm.

Shaping the future of innovation in the semiconductor industry

Dell Technologies, an essential infrastructure company, is committed to solving business challenges and shaping the future of innovation in the semiconductor industry. Our proven track record of excellence and a deep understanding of the semiconductor industry includes a team of industry experts, and specialized resources that bring years of experience.

Dell Technologies is a member of the Global Semiconductor Alliance (GSA). GSA's mission is to accelerate the growth and increase the return on invested capital of the global semiconductor industry by fostering a more effective fabless ecosystem through collaboration, integration, and innovation. As a GSA community member, Dell Technologies works towards establishing an efficient, sustainable semiconductor ecosystem that promotes idea sharing and thought leadership to accelerate industry growth and the next generation of design infrastructure.



Leading semiconductor companies around the world count on Dell Technologies to accelerate business outcomes.

7 of 10

Installed at 7 of the top 10 largest semiconductor companies by revenue¹

50+

Used by 50+ organizations for semiconductor design, embedded software and application development, and silicon chip manufacturing workloads²

235+

Over 235 petabytes of Dell EMC PowerScale storage have been deployed at semiconductor companies worldwide³

Accelerate time-to-market – Lower manufacturing risks
Innovate faster with infrastructure optimized semiconductor design workloads

DellTechnologies.com/Semi

¹Based on EPS News report on semiconductor supplier ranking published in November 2019 and Dell Technologies internal analysis conducted in April 2020

^{2,3}Based on Dell Technologies internal analysis conducted in April 2020