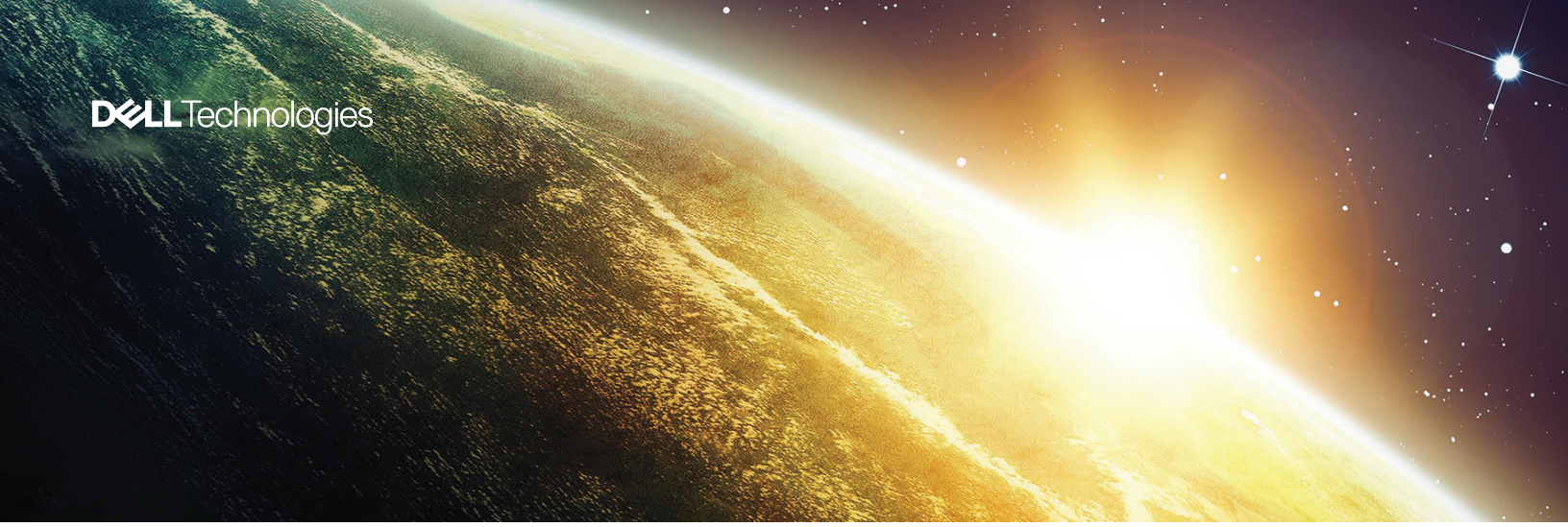

Dell EMC Ready Solutions for HPC Research

Make discoveries faster with artificial intelligence and high performance computing

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23.5 HPL PFLOPS supercomputer

helps researchers run weather simulations that save lives.[1]

390X

increase in farm production compared to traditional methods.[2]

Move quickly from raw data to actionable insights

To make discoveries, researchers must be able to draw actionable insights from massive amounts of data used to simulate complex systems. For decades, High Performance Computing (HPC) has been a powerful tool for scientific and academic research institutions, speeding workloads and improving time to results. Now, rapid advancements in processing power combined with massive amounts of real-time data are enabling adoption of artificial intelligence (AI) for research institutions across a variety of use cases.

While the advanced computing techniques of HPC, data analytics and AI have long been considered separate disciplines, they are converging as the industry recognizes that HPC is required to power the latest data analytics and AI algorithms. Today, increasingly powerful HPC systems can deliver the throughput and capacity needed to address complex research challenges such as handling massive amounts of data from simulations, sensors and scientific instruments to model, render and analyze, filter, classify and measure scientific data, and manage the time-criticality of research projects.

These advanced computing techniques gives researchers the power to accelerate the pace of discovery, creating more opportunities to break new ground, make important discoveries and solve some of the most important challenges of our time.

"The success we have had together reflects our close collaboration and a deep relationship, with attention to every detail, that lets us repeatedly deploy at the cutting edge of technology on-time and on-budget. With this new machine, we will further push the frontiers of science, offering researchers an instrument with capabilities they have never had before."[3]

—Dan Stanzione, Executive Director of TACC

Dell Technologies has what you need

Expertise and guidance

Technology is emerging quickly, so your team may not have had time to design, deploy and manage solution stacks optimized for emerging workloads. While AI might seem like the latest IT trend, Dell Technologies has been a leader in the advanced computing space for over a decade, with proven products, solutions and expertise. Dell has a team of data analytics, HPC and AI experts dedicated to staying on the cutting edge, testing new technologies and tuning solutions to your applications to help you keep pace with this constantly evolving landscape.

Dell EMC Ready Solutions for HPC

The advantage in today's marketplace goes to the data-driven enterprise. For many organizations, HPC is — or is becoming — an important source of competitive advantage. An optimized HPC solution delivers the compute, throughput and capacity needed to manage the rapid data growth and increased workload demands presented by advanced data analytics and a wide range of other workloads. Ready Solutions for HPC Research have been engineered to optimize investments with purpose-built designs, created to scale easier with modular building blocks, and to reduce the risk of potential software and hardware issues.

Solutions customized for your environment

Dell Technologies uniquely provides an extensive portfolio of technologies to deliver the advanced computing solutions that underpin successful data analytics, HPC and AI implementations. With years of experience and an ecosystem of curated technology and service partners, Dell provides innovative solutions, workstations, servers, networking, storage and services that reduce complexity and enable you to capitalize on the promise of data analytics, HPC and AI.

[1] Frontera supercomputer at the Texas Advanced Computing Center (TACC). Source: Top500 The List, June 2020, June 2020.

[2] eWeek, How Dell EMC is Doing Enterprise AI the Right Way, October 2019.

[3] Dell Technologies case study, A New 'Frontera,' 2019.

"We have roughly 800 researchers on the system, spread out over 300 different projects. The number of jobs we're putting through the system has been quite impressive for the size of the system. The throughput has been extraordinarily good. The overall usage allocation has been close to 100%. And, of course, the queue times have been very low."[4]

—Lev Lafayette, Platforms Computing and Training Officer, University of Melbourne

Do any of these challenges sound familiar?

"We need to be sure we're getting the required performance from our budget."
Budgets tend to be tighter for academic and research institutions than for commercial enterprises. To optimize budget, it's critical to match HPC resources to requirements to avoid costly overprovisioning. Choose a solution stack tailored for your unique requirements — one that is based on performance, efficiency or a balance of both. The Dell Technologies HPC team can help optimize investments on limited budgets with the ability to tune solutions for specific workloads.

"We have trouble providing the immense computational power and storage capacity required for research."
Researchers need fast, accurate results to investigate, understand and predict increasingly complex phenomena. A balanced HPC solution can deliver the throughput and capacity needed to manage rapid data growth and increased workload demands. Dell EMC Ready Solutions for HPC make it easy to scale with modular, IT building blocks designed for research applications.

"Performing design, deployment, integration and performance tuning is complex."
Deploying a fast, reliable HPC solution can be a significant investment of time and IT resources, with a chance for errors. Aspects of HPC solutions are interconnected and impact the overall success, performance and productivity of the solution. Dell Technologies reduces risk by allowing customers to test and tune solutions prior to purchase in worldwide Customer Solution Centers. Customers and partners can also evaluate new HPC technologies prior to general availability in the HPC & AI Innovation Lab.

Dell EMC Ready Solutions for HPC Research

Dell Technologies has invested to create a portfolio of Ready Solutions designed to simplify the configuration, deployment and management of HPC clusters. These trusted designs have been optimized, tested and tuned for a variety of key use cases. They include the servers, storage, networking, software and services that have been proven in our labs and in customer deployments to meet workload requirements and customer outcomes. The modular solution building blocks provide a customized yet validated approach for deploying new clusters, scaling or upgrading their existing environments.

Ready Solutions for HPC Research have been engineered to optimize investments with purpose-built designs, created to scale easier with modular building blocks, and to reduce the risk of potential software and hardware issues.

Optimize investments

Dell EMC Ready Solutions for HPC Research are built with flexible, industry-standard building blocks of compute, networking and storage tested and tuned by Dell Technologies engineering with HPC applications. These purpose-built HPC building blocks are then tailored to speed deployment, help eliminate potential software and hardware issues, and optimize performance. Dell Technologies also offers consulting, education, deployment, support and remote management services to optimize solution productivity and efficiency.

[4] Dell EMC case study, The University of Melbourne, accessed October 2020.

Optimize investments

Scale easily

Reduce risk

Scale easily

When speed to results matters, Dell Technologies experts can help build an HPC solution that addresses growing research challenges. Dell EMC HPC solutions leverage a flexible building-block approach to easily scale over time. Scale by adding reources such as memory or hard drives inside PowerEdge servers. Add external storage with Dell EMC PowerVault storage arrays, or Isilon scale-out network-attached storage (NAS). Dell Technologies is an industry leader in creating HPC solutions — regardless of size or complexity — that deliver fast setup with a wide range of optional services. With proven success in thousands of implementations worldwide, you can be confident growing with Dell Technologies.

Reduce risk

Dell Technologies is committed to helping more people make more innovations and discoveries than any other technology provider in the world. That's why Dell Technologies engineers and industry experts work in collaboration with Dell Technologies customers and partners to design, deploy and scale HPC solutions for research applications. It not only saves time, it also reduces the risk of potential hardware and software issues. See performance test results for yourself at hpcatdell.com. Test your code via one of the Dell Technologies' worldwide Customer Solution Centers and/or in the HPC & AI Innovation Lab. Around the world, more than 34,000 full-time Services and Support experts are available every step of the way with consulting, education, deployment, management and support.[5]

Customer success stories

European Council for Nuclear Research (CERN)

4X performance increase	**300** servers can be deployed in 30 minutes	**5%** energy usage from CPUs, reduced from 20%

View the case study video: CERN

Texas Advanced Computing Center (TACC)

38.7 PFLOPS	**#1** fastest academic supercomputer	**16K** plus Intel Xeon processors

Read the case study: A New 'Frontera.'

Lincoln Laboratory at MIT TX-Green System

1+ PFLOPS total peak performance	**4X** capacity boost

View the case study video: MIT Lincoln Laboratory.

- The University of Cambridge uses HPC and AI to solve some of today's most demanding data-driven simulation challenges — from those involving medical imaging and genomic analysis to the mapping of exoplanets.
- Swinburne University of Technology inspires a new generation of scientists with an HPC supercomputer that enables advanced cosmological research.
- TGen uses advanced computing to fight rare diseases.

[5] Dell Technologies, "Te" September 2019.

Technical specifications

The options below serve as a starting point for a customizable, yet validated solution. A Dell Technologies HPC specialist can assist you with designing an HPC solution for your specific needs and environment. See performance test results at hpcatdell.com.

Explore Virtual Rack at http://esgvr.dell.com/

Ready Solutions for HPC Research

PowerEdge servers	Compute nodes	**Choice of:** R440, R640, R740/xd, R840, R940, M640, C4140, C6420	R6515, R7515, R6525, R7525, C6525
	Processors	Intel® Xeon® Scalable	AMD® EPYC™ 7000 series
	Accelerator nodes	**Choice of:** C4140, R740	**Choice of accelerators:** NVIDIA® T4, P40, V100 In PowerEdge C4140, V100 16GB and 32GB SXM2 and PCIe
Software	Bright	Red Hat® Enterprise Linux® Bright Cluster Manager® Mellanox® OFED NVIDIA CUDA®	Intel Fabric Suite (IFS) Omni-Path Dell EMC Deployment Toolkit Dell EMC OpenManage
	OpenHPC	Red Hat Enterprise Linux OpenHPC™ Mellanox OFED IFS	Note: OpenHPC does not have accelerator support Dell EMC Deployment Toolkit Dell EMC OpenManage
Networking			
Omni-Path (OPA) for Intel-based servers	Host fabric interface (HFI)	Intel Omni-Path HFI adapter 100 series 1 port PCIe x16	
	Switches	Dell EMC Networking H1000 Edge series: H1048 and H1024 Dell EMC Networking H9100 series	
	IFS driver stack	10.9	
InfiniBand® (IB)	IB host channel adapters	**Rack:** Mellanox ConnectX®-6 HDR 100 Mellanox ConnectX-5 EDR single port or Mellanox ConnectX-3 FDR dual port	Mellanox ConnectX-3 small form factor (SFF) for blades: FDR or FDR10 mezzanine cards HDR: Mellanox ConnectX-6
	IB switches: HDR, FDR and EDR	**Rack:** Mellanox SwitchX®-6xxx series Mellanox SB 77xx and 78xx series Mellanox MSB 78xx series Mellanox QM 87xx series	Mellanox M4001F or M4001T supported on M640 blades HDR: Mellanox QM-8700 series
	IB drivers	Mellanox OFED	
Ethernet	NICs	1, 10, 25, 40GbE (full and low profile)	
	Dell EMC PowerSwitch	Z and S series switches	
Storage	NFS	Dell EMC Ready Solutions for HPC NFS Storage	
	Lustre®	Dell EMC Ready Solutions for HPC Lustre Storage	
	Isilon	Dell EMC Isilon Scale-out NAS	
	SAS RAID controller	PERC 10	
Services		Consulting, education, hardware deployment and support, remote management, cloud options, financing	

Solution highlights

- Dell EMC PowerEdge servers enhance performance across the widest range of applications with highly scalable architectures and flexible internal storage.
- Dell EMC Ready Solutions for HPC NFS Storage are reliable, easy to administer and have very good performance within certain boundaries.
- Dell EMC Ready Solutions for HPC Lustre Storage customers tap into the power and scalability of Lustre with simplified installation, configuration and management features.
- Bright Cluster Manager enables the deployment of clusters over bare metal with a management view that spans the hardware, operating system, software and users.

"We test every piece of hardware, believe it or not. Dell EMC is the only server that can hold up to the type of work that we are pounding on these boxes. Other boxes will fail, and we will end up with them down. And so a big reason that we have Dell EMC servers is because they are bulletproof — you can drop them on their head and they still run — and they are fast."[6]

—Christopher Sullivan, Assistant Director for Biocomputing, Center for Genome Research and Biocomputing, Oregon State University

Services and financing

Dell Technologies is there every step of the way, linking people, processes and technology to accelerate innovation and enable optimal business outcomes.

- Consulting Services are delivered by certified experts to help you get the business value of advanced computing. The services include an assessment, workshop, testing, proofs of concept and production implementation. These experts help determine where advanced computing is a good fit for your organization. They also help you build your own internal team of experts through knowledge transfer at each step.
- Education Services offers courses and certifications in data science and advanced analytics through self-paced online labs and instructor-led workshops.
- Deployment experts have the experience, expertise and best practices to enhance your success with data analytics, HPC and AI solutions. With a proven track record of success in thousands of engagements worldwide, you can rely on Dell EMC as your partner.
- Support experts can provide comprehensive hardware and collaborative software support 24x7 for optimal system performance and minimized downtime. ProSupport includes next-business-day on-site service with four- and eight-hour parts-and-labor response options, and escalation management with customer-defined severity levels. You can also opt for ProSupport Plus to get a technology service manager, who serves as a single point of contact for your support needs.
- Once the HPC cluster is deployed, Remote HPC Cluster Management services help keep it running smoothly with proactive monitoring and management of the entire HPC solution.
- Financial Services offers a wealth of leasing and financing options to help you find opportunities when your organization faces decisions regarding capital expenditures, operating expenditures and cash flow.

[6] Dell Technologies blog, Powering Scientific Research with Dell EMC and AMD, November 2019.

"Thanks to the strong collaboration of Dell EMC, we now have an efficient, intensive, and stable platform for high performance computing systems, with significantly greater IT efficiency and a 30% lower TCO."[7]

—Dr. Chen Jiawei, School of Systems Science, Beijing Normal University

Why choose Dell Technologies for data analytics, HPC and AI

We're committed to advancing data analytics, HPC and AI, and we've dedicated a great deal of resources toward that goal.

- Schedule an executive briefing and collaborate on ways to reach your business goals.
- Dell Technologies Customer Solution Centers are staffed with computer scientists, engineers and subject matter experts in a variety of disciplines.
- We are committed to providing you with choice. We want you to get what you need and have a great experience working with us. If we don't have what you need, we'll tell you who does. We believe in being open, and we publish our performance results at hpcatdell.com.
- Dell Technologies is the only company in the world with a portfolio that spans from workstations to supercomputers, including servers, networking, storage, software and services.
- Because Dell Technologies offers such a wide selection of solutions, we can act as your trusted advisor without trying to sell you a one-size-fits-all approach to your problem. That range of solutions has also given us the expertise to understand a broad spectrum of challenges and how to address them.

Customer Solution Centers

Our global network of dedicated Dell Technologies Customer Solution Centers are trusted environments where world-class IT experts collaborate with you to share best practices, facilitate in-depth discussions of effective business strategies and help your business become more successful and competitive. Dell Technologies Customer Solution Centers reduce the risks associated with new technology investments and can help improve speed of implementation.

AI Experience Zones

Curious about AI and what it can do for your business? Run demos, try proofs of concept and pilot software in Singapore, Seoul, Sydney, and Bangalore Customer Solution Centers. Dell Technologies experts are available to collaborate and share best practices as you can explore the latest technology, get the information and hands-on experience you need for your advanced computing workloads.

HPC & AI Innovation Lab

The Dell Technologies HPC & AI Innovation Lab in Austin, Texas, is the flagship innovation center. Housed in a 13,000-square-foot data center, it gives you access to thousands of Dell EMC servers, three powerful supercomputers, and sophisticated storage and network systems. It's staffed by a dedicated group of computer scientists, engineers and subject matter experts who actively partner and collaborate with customers and other members of the HPC community. The team engineers HPC and AI solutions, tests new and emerging technologies, and shares expertise including performance results and best practices.

[7] Dell Technologies case study, Efficient computing — accelerating systems science research, 2019.

"The goal is always to push the boundaries of knowledge and inspire the next generation of scientists. With this new system from Dell EMC, I believe we can do that."[12]

—Jarrod Hurley, Professor of Astrophysics, Swinburne University of Technology

HPC & AI Centers of Excellence

As data analytics, HPC and AI converge and the technology evolves, Dell Technologies worldwide HPC & AI Centers of Excellence provide thought leadership, test new technologies and share best practices. They maintain local industry partnerships and have direct access to Dell and other technology creators to incorporate your feedback and needs into their roadmaps. Through collaboration, Dell Technologies HPC & AI Centers of Excellence provide a network of resources based on the wide-ranging know-how and experience in the community.

Proven results

Dell Technologies holds leadership positions in some of the biggest and largest-growth categories in the IT infrastructure business, and that means you can confidently source your information technology needs from Dell Technologies.

- #1 in servers[8]
- #1 in converged and hyper-converged infrastructure (HCI)[9]
- #1 in storage[10]
- #1 cloud IT infrastructure[11]

See Dell Technologies Key Facts.

Take the next step, today

Don't wait to find out how Dell Technologies can simplify and speed your adoption of engineering tested, validated solutions for research applications and workloads. Contact your Dell Technologies or authorized channel partner representative for more details right away.

[8] IDC WW Quarterly Server Tracker, Units & Revenue, September 2020.

[9] IDC WW Quarterly Converged Systems Tracker, Vendor Revenue, September 2020.

[10] IDC WW Quarterly Enterprise Storage Systems Tracker, Vendor Revenue, September 2020.

[11] IDC WW Quarterly Cloud IT Infrastructure Tracker, Vendor Revenue, September 2020.

[12] Dell EMC case study, Swinburne University, Accessed October 2020.

Contact us

To learn more, visit DellTechnologies.com/HPC or contact your local representative or authorized reseller.

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