# Dell EMC Ready Bundles for HPC Storage

Making enterprise HPC storage simpler, more reliable and cost-effective

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## Improved access to HPC is generating unprecedented amounts of data

As increasingly powerful and sophisticated high-performance computing (HPC) technologies burst into the mainstream, more researchers and engineers are empowered to make new innovations and discoveries faster than ever before.

Data from these systems continues to drive the demand for high-performance storage. The flood of information generated by sensors, satellites, high-performance computer simulations, high-throughput devices and medical imaging is pushing data repositories to sizes that were once inconceivable. Researchers can generate and consume data in HPC systems at such speed that multiple petabytes to exabytes are starting to become commonplace with HPC. And the data requirements around performance and capacity keep increasing rapidly.

Because storage input/output (I/O) capabilities have typically lagged behind data processing horsepower, storage components can turn into a major bottleneck. Plus, managing and monitoring these complex storage systems significantly adds to the burden on storage administrators and researchers. Ideally, HPC storage systems should provide large-capacity, highly scalable and high-speed storage that won't strain internal IT expertise or the data center budget. But increasing the throughput and scalability of storage systems supporting the HPC system can require a great deal of planning and configuration.

### Optimum HPC performance requires simple, reliable and cost-efficient storage

Dell EMC Ready Bundles for HPC Storage are preconfigured, tested and validated solutions that allow you to deploy large-capacity storage systems more easily and with less risk, while preserving resources and budget for higher-value activities. They also give you the power to quickly and easily scale storage capacity as computing needs grow.

## Simplified

**Simple**

Dell EMC and our expert industry partners, such as Intel®, have designed tested, validated solutions that vastly reduce the time spent on design, validation, testing and tuning — so you can stay focused on your business or research objectives.

## Reliable

**Reliable**

Dell EMC Ready Bundles for HPC Storage are supported, commercial-ready HPC storage systems, designed to remove the guesswork from HPC storage.

## Cost-efficient

**Cost-efficient**

Built on cost-optimized industry-standard compute, storage and networking with streamlined management tools, Dell EMC Ready Bundles for HPC Storage are designed to provide excellent performance for the money.

## Test drive HPC

You can work directly with Dell EMC HPC experts to test-drive cutting-edge HPC technologies, and test and tune systems prior to purchase — at no cost to you — at worldwide Dell EMC HPC Innovation Centers:

- The Dell EMC HPC and AI Innovation Lab
- The Dell EMC/Cambridge HPC Solution Centre
- The Dell EMC/Intel Competence Centre for Cloud and HPC at the University of Pisa
- San Diego Supercomputer Center
- Texas Advanced Computing Center
- Centre for High Performance Computing, South Africa

Contact your authorized Dell EMC or authorized channel partner to get access.

## What are your HPC storage challenges?

**"It's complex to plan and deploy HPC storage solutions."**

Designing high-throughput, highly scalable HPC storage systems requires a great deal of expert planning and configuration. In addition, working with multiple vendors to acquire, deploy and support an HPC storage system is difficult and time consuming.

Dell EMC Ready Bundles for HPC Storage are delivered with hardware, software and professional support from Dell EMC. Each system is based on development and tuning in the Dell EMC HPC and AI Innovation Lab, so you get storage solutions based on detailed performance and sizing characterizations, tuning configuration and best practices. Preconfiguration and tuning simplify installation to provide faster time to results.

Dell EMC Ready Bundles for HPC Storage also simplify monitoring and overall management of HPC storage, without requiring specialized training or expertise to operate, making storage simpler to maintain. Worry-free HPC deployment and management frees researchers, scientists and engineers to focus on core business and strategic research initiatives instead of managing HPC clusters.

**"We need stable and secure storage systems for our critical data sets."**

Dell EMC Ready Bundles for HPC Storage take the guesswork out of configuration, reducing interoperability issues and improving service quality. The systems are built on Dell EMC PowerEdge servers and Dell EMC PowerVault storage to provide redundancy. Dell EMC engineers and industry experts have worked in collaboration with Dell EMC HPC customers and partners to design these systems in our Dell EMC HPC and AI Innovation Lab. The Dell EMC engineering team then devotes hours to rigorously tuning the system for your specific applications and workloads. The result is storage that's highly available, with no single point of failure.

In addition, included Dell EMC ProSupport covers the storage solution in its entirety, both hardware and software, to help prevent and address potential software and hardware issues with a single source of support.

**"It's tough to scale capacity and performance to meet user demands — and stay within budget."**

Dell EMC is leading the charge to mainstream HPC by bringing costs down so this technology is available for all. Dell EMC Ready Bundles for HPC Storage allow you to meet your capacity and performance needs with compelling total cost of ownership (TCO) benefits. First, cost-optimized, industry-standard Dell EMC servers, storage and networking decrease the cost to store and process large HPC data sets. Then, preconfigured, tuned and tested solutions lower the costs of planning and deploying HPC storage. Cost-effective network file system (NFS) storage is available with virtually all Linux® distributions — lowering acquisition costs. It's easy to configure, deploy and maintain — lowering operational costs. Lustre® features user interface–driven configuration, monitoring and overall management to lower management complexity and cost.

## Dell EMC Ready Bundles for HPC Storage

Dell EMC gives you the choice of two different Ready Bundles for HPC Storage, along with the flexibility to customize a solution for your specific needs.

### Dell EMC Ready Bundle for HPC NFS Storage

**Low cost, scalable and performant HPC storage for lower I/O needs**

Storage solutions based on the NFS protocol are widely used for HPC clusters because NFS is simple and time-tested, and is a standard package in virtually every Linux distribution. These characteristics make NFS an attractive storage solution for many HPC installations.

If you have clusters running applications with lower I/O needs, NFS storage is reliable, easy to administer and has very good performance within certain boundaries. In clusters with higher I/O requirements, NFS is a good option for a secondary storage repository for home directories, application storage and longer-term storage of application data.

**Solution benefits**

- **Low cost:** Compute, storage, networking and software are optimized together to provide excellent performance and scalability for the money.
- **Performant:** The Dell EMC Ready Bundle for HPC NFS Storage is tuned for throughput performance. Maximum random write performance is up to 6.5K IOPS, with maximum random read performance up to 18.7K IOPS.[1]
- **Scalable:** Meet future needs more easily with the ability to scale easily up to 64 nodes and 480TB raw capacity in a supported single namespace to run larger, more complex applications with faster throughput capacity.

| Dell EMC Ready Bundle for HPC NFS Storage technical specifications | |
|---|---|
| Server | 2x PowerEdge R740 Servers |
| Processor | Dual Intel Xeon® Gold 6136, 3.0GHz, 12 cores per processor |
| Network connectivity | **Choice of:**<br>• Dell EMC H-Series based on the Intel Omni-Path Architecture<br>• Mellanox® InfiniBand® EDR<br>• 10/40GbE |
| Memory | 12x 16GiB 2666 MT/s RDIMM per server |
| Local disks and RAID controller | PowerEdge RAID (PERC) H730P with 5x 300GB 15K SAS hard drives |
| External storage controller | 2x 12Gbps SAS HBAs per server |
| Storage system | 1x PowerVault MD3460 enclosure and 1x MD3060E enclosure for the 480TB solution<br>Duplex RAID controllers in the MD3460 storage array<br>60x 4TB 7.2K NL SAS drives per enclosure, 120x 4TB disks in total |
| Systems management | Integrated Dell Remote Access Controller 9 (iDRAC9) Enterprise<br>OpenManage Server Administrator |
| Operating system | Red Hat® Enterprise Linux (RHEL 7.4) x86_64 |
| Cluster suite | Red Hat Cluster Suite from RHEL 7.4 |
| File system | Red Hat Scalable File System (XFS) v9.1.0-2757 |

[1] Dell EMC white paper, "Dell HPC NFS Storage Solution – High Availability (NSS7.0-HA) Configuration" May 2016.

## Dell EMC Ready Bundles for HPC

Now, small and medium enterprises can achieve profit or discovery goals faster with modular HPC solutions from Dell EMC.

Dell EMC Ready Bundle for HPC Life Sciences

Infrastructure architected to deliver high throughput and fast turnaround for a diverse range of fields, including drug design, cancer research, agriculture, biofuels and forensics.

Dell EMC Ready Bundle for HPC Manufacturing

A flexible building-block approach to building HPC systems for design simulations, including structural analysis and computational fluid dynamics.

Dell EMC Ready Bundle for HPC Research

A solution that enables research centers to quickly develop HPC systems that match the unique needs of a wide variety of workloads involving complex scientific analysis.

## Dell EMC Ready Bundle for HPC Lustre Storage

### High performance, massively scalable and cost-effective HPC

Today's HPC workloads require storage infrastructure that scales endlessly and delivers unmatched I/O levels. Lustre solutions can be complicated and time-consuming to deploy. The Dell EMC Ready Bundle for HPC Lustre Storage parallel file storage solution allows you to scale efficiently both up and down to suit your workloads without losing performance or capacity, so you can tap into the power and scalability of Lustre with simplified installation, configuration and management features — on cost-optimized industry-standard Dell EMC systems.

### Solution benefits

- **High performance:** Run larger and more complex applications faster with over a petabyte in sustained capacity. Customers also have the option to leverage Mellanox InfiniBand EDR or Intel Omni-Path for high-speed, low-latency storage transactions
  - **Mellanox InfiniBand EDR:** Peak write performance is 15GB/s; peak read performance is 18.5GB/s for sequential operations. Peak random write performance is 17.5K IOPS and reaches 45K IOPS at 256 threads for random reads.[2]
  - **Dell EMC H-Series based on the Intel Omni-Path Architecture:** Peak write performance is 14.9GB/s; peak read performance is 16.8GB/s for sequential operations. Peak random write performance is 15.6K IOPS and reaches 46K IOPS at 256 threads for random reads.[3]
- **Massively scalable:** Dell EMC Ready Bundle for HPC Lustre Storage provides 960TB of raw storage for each object storage server (OSS) pair, and scales efficiently both up and down to suit workloads without losing performance. You can start small and scale to tens of thousands and beyond an exabyte in capacity. Scaling will increase both the total network throughput, as well as the storage capacity at once. This allows for an increase in the volume of storage available while maintaining a consistent maximum network throughput.
- **Cost-effective:** Get more system performance for your budget and protect IT investments with simplified solutions for scaling out. Dell EMC and Intel have bundled a tested, validated solution that removes guesswork so you can stay focused on your business or research objectives and get excellent return on investment.

[2] Dell EMC white paper, "Dell HPC Lustre Storage with Mellanox InfiniBand EDR," September 2016.

[3] Dell EMC white paper, "Dell HPC Lustre Storage with Intel Omni-path" September 2016.

**Winner of the coveted HPCwire Editor's Choice Award for Best Use of High Performance Data Analytics[14]**

| Dell EMC Ready Bundle for HPC Lustre Storage technical specifications | |
|---|---|
| Servers | Management server (IML): 1x PowerEdge R640 Server<br>Lustre Metadata servers (MDS): 2x PowerEdge R740 Servers<br>Lustre OSS: 2x PowerEdge R740 Servers |
| Processor | IML: 2x Intel Xeon Gold 5118 @ 2.3GHz, 12 cores per processor<br>MDS and OSS: 2x Intel Xeon Gold 6136 @ 3.0GHz, 12 cores per processor |
| Network connectivity | **Choice of:**<br>• Dell EMC H-Series based on the Intel Omni-Path Architecture<br>• Mellanox InfiniBand EDR<br>• 10/40GbE |
| Memory | IML: 12x 8GiB 2666 MT/s RDIMMs per server<br>MDS and OSS: 24x 16GiB 2666 MT/s RDIMMs per server |
| Local disks and RAID controller | IML: PERC H740P Integrated RAID, 8GB NV cache, 6x 300GB 15K SAS hard drives configured in RAID10 for OS and IML database storage<br>MDS and OSS: PERC H330+ Integrated RAID, 2x 300GB 15K SAS hard drives configured in RAID1 for OS |
| Software | Lustre Community Edition v2.10.3 |
| Systems Management | iDRAC9 Enterprise |
| Operating system | CentOS™ 7.4 x86_64<br>RHEL 7.4 x86_64 |
| OST storage array | 4x PowerVault MD3460 with 240x 3.5 in. 7.2K RPM NL SAS drives |
| MDT storage array | 1x PowerVault MD3420 with 24x 2.5 in. 300GB NL SAS drives |
| External storage controllers | OST: 4x SAS 12Gbps HBA LSI 9300-8e<br>MDS: 2x SAS 12Gbps HBA LSI 9300-8e |

## Why Dell EMC?

The combination of Dell and EMC brings together two industry-leading companies with strong reputations for value and innovation. Dell EMC 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 IT needs from one provider — Dell EMC.

- #1 in both number and size of XSEDE HPC systems for U.S. open science[4]
- #1 fastest supercomputer on the African continent[5]
- #1 hyper-converged systems[6]
- #1 converged infrastructure[7]
- #1 in traditional and all-flash storage[8]
- #1 virtualized data center infrastructure[9]
- #1 cloud IT infrastructure[10]
- #1 server virtualization and cloud systems management software (VMware®)[11]
- #1 in data protection[12]
- #1 in software-defined storage[13]

[4] Dell EMC has the most systems in XSEDE, including the largest system. Systems include SDSC Comet, SDSC, TACC Jetstream, TACC Stampede, LSU SuperMIC and TACC Wrangler. TACC Stampede is the largest system in XSEDE. See "XSEDE High Performance Computing."

[5] The Next Platform, "South African Lengau System Leaps Towards Petaflops," June 2016.

[6] IDC WW Quarterly Converged Systems Tracker, December 2017, Vendor Revenue — CY17Q3.

[7] IDC WW Quarterly Converged Systems Tracker, Q1 2017, June 2017, Vendor Revenue.

[8] IDC WW Quarterly Enterprise Storage Systems Tracker, September 2017, Vendor Revenue — EMC Q2 2017.

[9] Dell EMC Annual Report, 2015.

[10] IDC WW Quarterly Cloud IT Infrastructure Tracker, April 2017, Vendor Revenue — EMC Q4 2016.

[11] IDC WW Virtual Machine and Cloud System Market Shares 2016, July 2017.

[12] Dell EMC Pulse, "Gartner Recognizes EMC as a Leader in the 2016 Data Center Backup and Recovery Software Magic Quadrant," June 2016.

[13] IDC WW Semiannual Software Tracker, 2H2016, April 2017.

[14] HPCwire, "HPCwire Reveals Winners of the 2016 Readers' and Editors' Choice Awards at SC16 Conference in Salt Lake City," November 2016.

## Services and financing

### Dell EMC Professional Services

**Solutions customized for your needs**

Leverage on-site integration or application implementation with Dell EMC Professional Services.

**Deployment assistance when you need it**

You can trust Dell EMC to deploy the racked configuration in your data center, including network cabling, operating system, firmware and hypervisor with Dell EMC ProDeploy.

**Support is always on for you**

Enjoy unlimited access to 24x7 chat, email and phone support services with how-to assistance and disaster recovery from Dell EMC ProSupport.

**Dell EMC Customer Solution Centers**

Experience Dell EMC solutions in our global network of 21 dedicated facilities The Dell EMC Customer Solution Centers are trusted environments where world-class IT experts collaborate with you to share best practices, and facilitate in-depth discussions of effective business strategies using briefings, workshops or proofs-of-concept to help you become more successful and competitive Dell EMC Customer Solution Centers reduce the risk associated with new technology investments and can help improve speed of implementation.

### Dell Financial Services

- Leasing and financing solutions are available throughout the U.S., Canada and Europe.
- Dell Financial Services can finance the total technology solution.
- Efficient electronic quoting and online contracts offer the best customer experience.

Learn more about Dell Financial Services.

## Expand your HPC storage today

Contact your Dell EMC or authorized channel partner representative today to see how your organization can benefit from simple, reliable, and cost-effective Dell EMC Ready Bundles for HPC Storage.

## Contact us

To learn more, visit dellemc.com/hpc or contact your local representative or authorized reseller.