



WHITE PAPER

SOLUTIONS FOR HEALTHCARE: **DELL EMC POWERMAX AND CLOUDIQ**

Deliver faster and safer patient care
with an always-on data-driven solution
for your Epic EHR environment

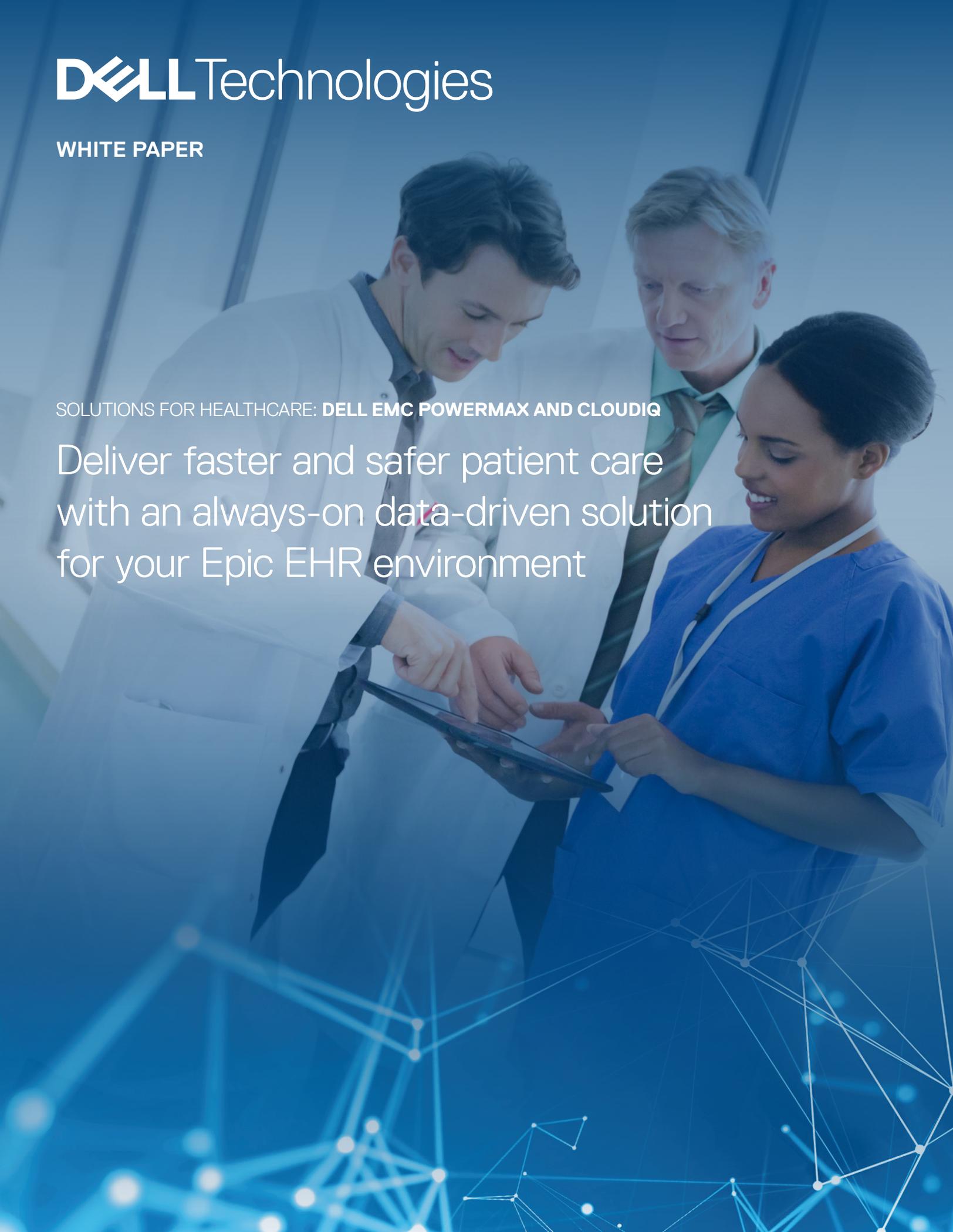


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EXECUTIVE SUMMARY

Today's healthcare organizations are undergoing digital transformation in an effort to drive value in care through more efficient processing and processes while reducing uncertainty, time, and costs. The convergence of value-based reimbursement, shrinking hospital margins, and all-time high healthcare spending is pushing these organizations to consider new partnerships and paradigms to achieve efficiencies and cost control. With continued merger and acquisition activity coupled with more organic growth, healthcare organizations are pushing their data workloads to the limit, especially with respect to electronic health records (EHR).

Unprecedented healthcare data growth is also straining current technology infrastructure as the following trends occur:

- Patient numbers increase, with both aging and chronic disease populations growing every day¹
- New healthcare applications are being introduced at staggering rates, spanning home care to acute care to research and beyond
- The scope of mission-critical workloads expands to support such initiatives as population health, telehealth, connected health, clinical research, 360-degree patient views, and precision medicine
- Systems of record, including enterprise resource planning (ERP) platforms, EHR platforms like Epic, and enterprise content management (ECM) systems are growing at an unprecedented rate and scale
- Clinicians and patients alike require up-to-the-minute information delivered in real time to support the latest healthcare applications and services

These growing IT challenges are placing significant demands on storage capabilities—including performance, data efficiency, management, and security.

Accelerate your mission-critical workloads

With the need for rapid patient diagnosis and uninterrupted treatment at the point of care, physicians and other care providers require immediate and secure access to patient data at “the speed of now.” This places massive performance demands on the storage infrastructure with consistent data availability, an absolute necessity for mission-critical workloads supporting EHR systems. Downtime is obviously unacceptable, but slowdowns are equally so, because they can put patient safety at risk.

Beyond performance and data-availability demands, there is also a growing need for massive data consolidation as healthcare organizations merge and applications like EHR become increasingly more interdependent across the continuum of care. Legacy applications and siloed data



Top Trend in Healthcare: Industry Consolidation

In a survey of more than 1,000 healthcare leaders, over 25 percent of respondents identified healthcare industry consolidations as the most important trend.² As consolidation happens at the business level, it must also occur at the workload level, especially with high-demand, heavy-transaction applications like EHR and ERP.

are being integrated with new data to enable immediate information access whenever and wherever needed. Clinicians also require greater data alignment to help create a complete patient view, while health IT requires consolidation to help modernize infrastructure and reduce management touch points.

EHR deployments and similar mission-critical workloads are especially demanding on health IT, requiring the maintenance and management of multiple production databases, each with multiple copies for simultaneous testing and development, reporting, and training. As such, database mirroring is required to ensure that these essential tasks do not interfere with even more mission-critical clinical operations.

Moreover, the rapid introduction of new technologies from medical IoT coupled with the unabated patient information explosion—with data points regarding history, images, reports, and physician notes being continuously added—is pushing storage capabilities to the limit. The answer for most organizations is to look for solutions that scale on demand while ensuring optimal use of existing hardware and/or cloud-based services.

Restrictions on budgets and resources are pushing IT departments to seek out-of-the-box functionality and push-button utilization for nonessential systems wherever possible to enable IT teams to keep their focus on delivering and supporting core solutions. Meanwhile, an increase in cybersecurity threats targeting healthcare and new and existing government mandates including HIPAA, HITECH, and GDPR are requiring health IT to rethink how to approach security and risk management.

Bottom line? Healthcare providers need to invest in a no-compromise storage solution to support high-demand mission-critical EHR and ERP workload requirements for now and in the future. To help with these requirements, Dell EMC PowerMax, the world's fastest storage array,³ and CloudIQ, a simplified, no-cost cloud-based monitoring tool, combine to deliver a powerful solution that tackles the unique storage demands of modern healthcare organizations.

NO-COMPROMISE STORAGE WITH REAL-TIME INTELLIGENCE

Dell EMC PowerMax and CloudIQ provide a uniquely powerful combination that addresses the demands of an always-on healthcare environment. Specifically, this two-pronged solution offers the no-compromise storage and real-time intelligence that healthcare environments require for:

- Exceptional performance for high-demand, heavy-transaction workloads
- High availability for 24x7x365 data accessibility
- High-data efficiency for massive consolidation of interdependent workloads
- Seamless copy data management with no interruption to daily operations
- Scale-up and scale-out architecture to address fluctuating data demands
- Simplified management with proactive monitoring

Why PowerMax for Clinicians

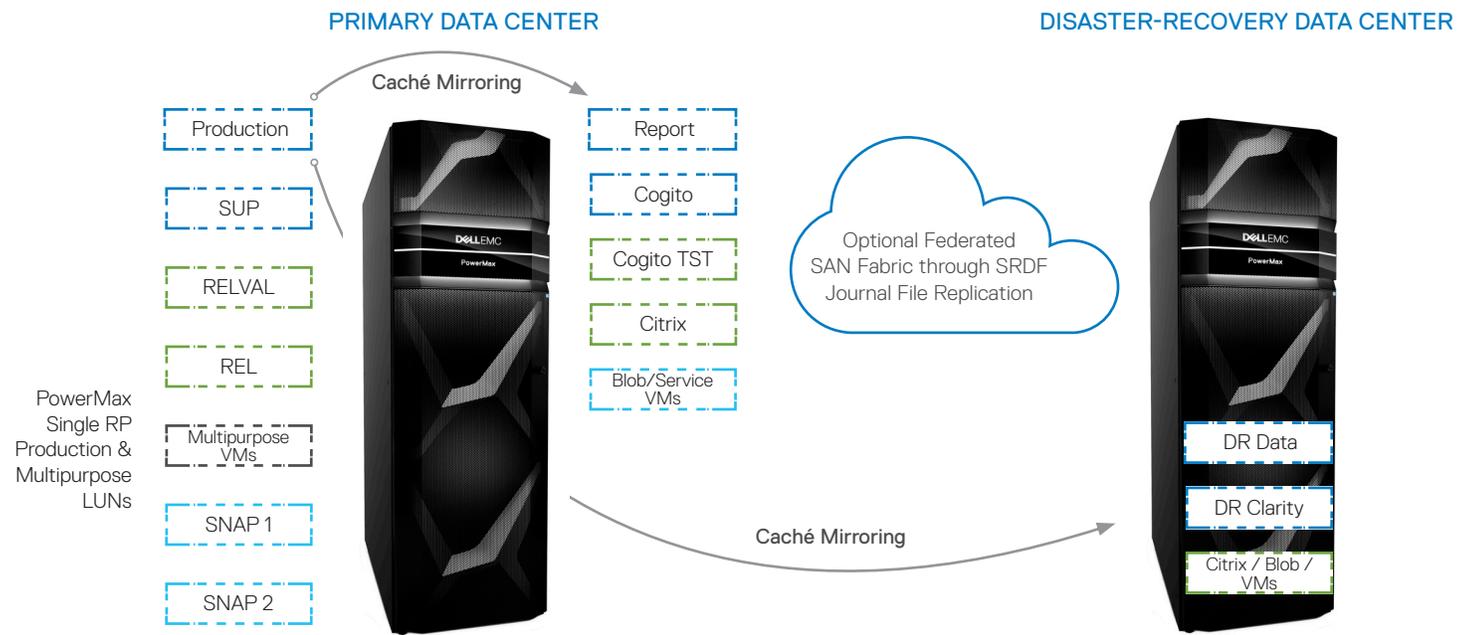
Dell EMC PowerMax provides uninterrupted access to critical patient data at the point of care and beyond—helping to improve care delivery with the speed and efficiency required to run healthcare's most demanding mission-critical workloads, including EHR and ERP, and next-gen applications supporting IoT, telehealth, advanced analytics, and more.

Why PowerMax for Health IT

Dell EMC PowerMax with CloudIQ brings together next-gen, intelligent technologies to automate processes and streamline monitoring while cutting footprint, power, and management costs.



Figure 1. Example Workload: Epic Reference Architecture for PowerMax. PowerMax makes a healthcare organization's EHR deployment fast and easy to use—providing the simplicity and performance of an all-flash NVMe array with data services, broad ecosystem support, and rock-solid reliability. Dell EMC has developed an Enterprise Reference Architecture based on optimal storage and backup and recovery configurations to meet Epic's availability and performance requirements. This reference architecture provides healthcare providers with the flexibility to select customized configurations that address their specific requirements.



Dell EMC PowerMax for Epic

More than 65 percent of Epic's customers leverage Dell EMC solutions to optimize their clinical applications.⁴ Many EHR customers who have Dell EMC VMAX storage arrays, the previous generation of the product family, are now turning to PowerMax as a best-in-class storage solution to help stay ahead of their EHR demands. PowerMax for Epic includes:

- **An Epic reference architecture:** Spanning the primary data center and the disaster-recovery data center to deliver the needed high availability and reliability to keep your EHR environment up and running (Figure 1).
- **Non-disruptive technology refresh:** To take advantage of this platform as quickly as possible, PowerMax provides seamless, non-disruptive migration from VMAX arrays and simple migration from third-party arrays.
- **Trusted technology:** Due to Epic's experience and history with PowerMax, the software company has bestowed the array with the distinction of "High Comfort" status (Table 1).^{5*}
- **Next-gen innovation:** Non-volatile memory express (NVMe) platforms are designed to enable next-gen storage technologies like storage-class memory (SCM) technology for persistent data. SCM provides further latency reduction and is ideal for EHR environments. Additionally, with PowerMax featuring NVMe, customers meet Epic's strict storage performance requirements for all Epic production operational database (ODB) environments.

Table 1. High-comfort level with Dell EMC VMAX and PowerMax^{5*}

	Dell EMC VMAX	Dell EMC PowerMax
Epic Comfort Level for Operational Database	HIGH	HIGH
Epic Comfort Level for Analytic Database	HIGH	HIGH

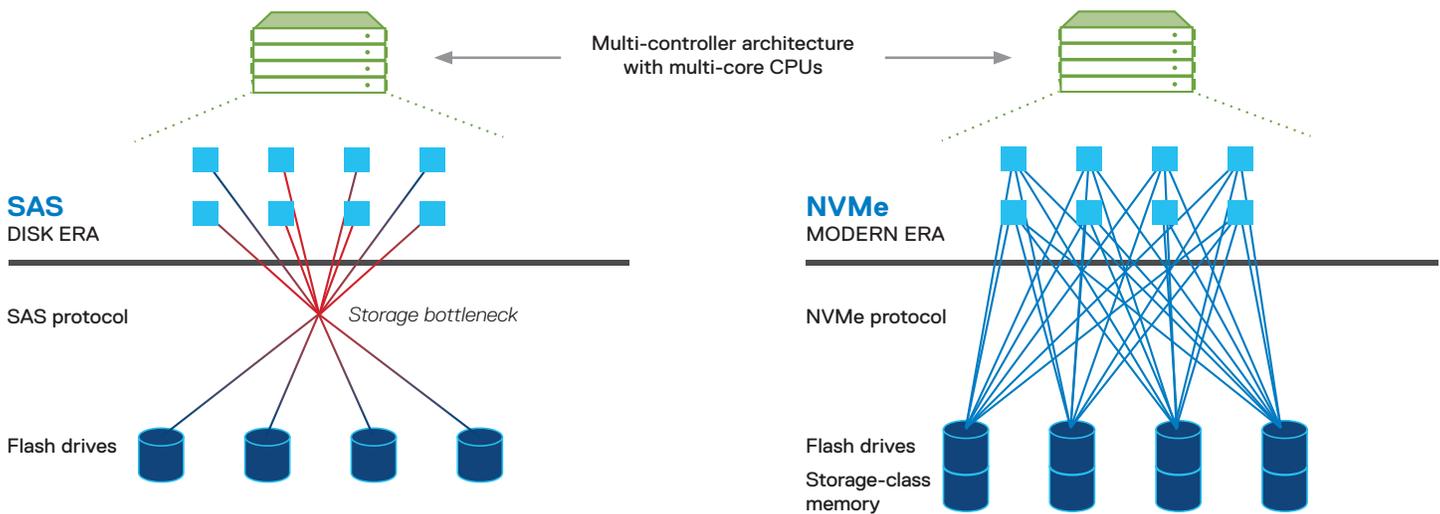
Exceptional performance for high-demand, heavy-transaction workloads including ERP and EHR

The end-to-end NVMe and built-in machine learning of Dell EMC PowerMax provide an infrastructure that ensures maximum performance without management overhead and supports data volumes unimaginable just a few years ago—such as the ability to analyze 40 million data sets in real time⁶ and make six billion decisions in a day.⁷ This improves access to critical data on every level and at every turn, for example: enabling healthcare providers to access multiple test results at the same moment at the point of care or enabling researchers to generate large data sets in one sitting to support data-intensive applications.

PowerMax, the world's fastest storage array,³ features:

- Up to 15 M IOPS⁸
- Up to 350 GB/s bandwidth⁹
- Sub-100 μs (microsecond) read response times¹⁰

Figure 2. NVMe maximizes the performance of flash in a multi-controller architecture, overcoming the storage bottlenecks of SAS.



NVMe done right

NVMe is a high-performance protocol for modern media designed to overcome the limitations of SAS, a storage protocol that was created for hard disk drives (Figure 1). NVMe takes advantage of the parallelism of modern CPUs and SSDs (and next-gen media) and removes the bottleneck from SAS by maximizing the power of flash drives and most importantly opens the door to the next media disruption with SCM. These performance and design advantages are resulting in rapid adoption of NVMe-storage platforms. In fact, according to IDC, more than half of all storage revenue will be generated by NVMe storage platforms by 2021.¹¹

However, because of the way they are built, traditional, niche, and proprietary storage arrays with NVMe often provide minimal user benefit, limit functionality, or introduce complexity by creating separate silos of storage for high-performance apps.

Only PowerMax delivers NVMe through future-proof hardware, intelligent software, and enterprise-proven data services, in addition to service levels built into machine learning and matched to customer levels.

High availability for 24x7x365 healthcare environments

Dell EMC PowerMax delivers no downtime if and when a component fails, no need for failover/failback processes, and no degradation in performance via a variety of features that are designed for six nines of availability with built-in remote protection required for healthcare. For example, PowerMax leverages advanced fault isolation, remote replication using industry-gold-standard Symmetrix Remote Data Facility (SRDF), robust data integrity, and a multi-controller scale-up and scale-out architecture to ensure critical workload migrations like Epic Caché databases remain online and available. Finally, PowerMax performs non-disruptive upgrades of all controllers in parallel and in memory, so there are no interruptions to patient care or to staff productivity.

High-data efficiency to consolidate workloads

Dell EMC PowerMax supports high data efficiency for massive consolidation of interdependent workloads—a benefit to any healthcare organization experiencing rapid growth and/or for those going through a consolidation or merger. These include:

- Inline and hardware data deduplication to automatically remove duplicate I/O blocks from the data before it is written to the flash media: global, dedupe-aware memory cache is aware of the deduplicated data, and content-based distribution inherently spreads the data evenly across all available resources within a cluster (Figure 3). This process enables scalable, global deduplication over the entire system in real time. When combined with compression, this can result in up to a 5:1 data reduction. Additionally, these features can be turned on or off at the app level to manage workloads as needed and are fully compatible with the use of all data services with no performance impact.
- The ability to consolidate complex workloads in a single environment using an easy-to-manage platform
- Consolidation of block and file to deliver consistent, predictable EHR performance

And with up to 4.4 PB of effective capacity, there is ample storage for multiple copies of EHR databases as well as various clinical and operational databases.

Seamless copy data management

In healthcare, copy data management can never have an impact on daily operations. To help, PowerMax leverages space-efficient snapshots that allow thousands of database copies to be created using near-zero storage capacity.

PowerMax also offers integrated copy data management (iCDM) tools that provide simple creation, management, orchestration, and automation of database copies, allowing

Figure 3. Inline deduplication and compression. PowerMax features inline deduplication and compression to minimize its storage footprint with up to 5:1 data reduction (average data reduction of 3:1). These data-reduction technologies are hardware-assisted and selectable together and can be turned on and off at the storage group level for maximum flexibility.

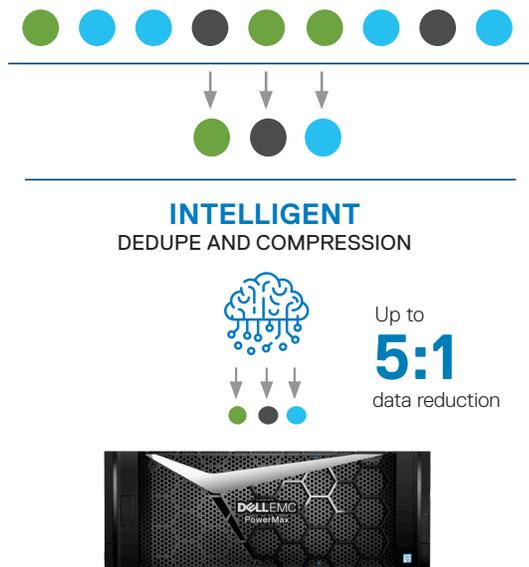
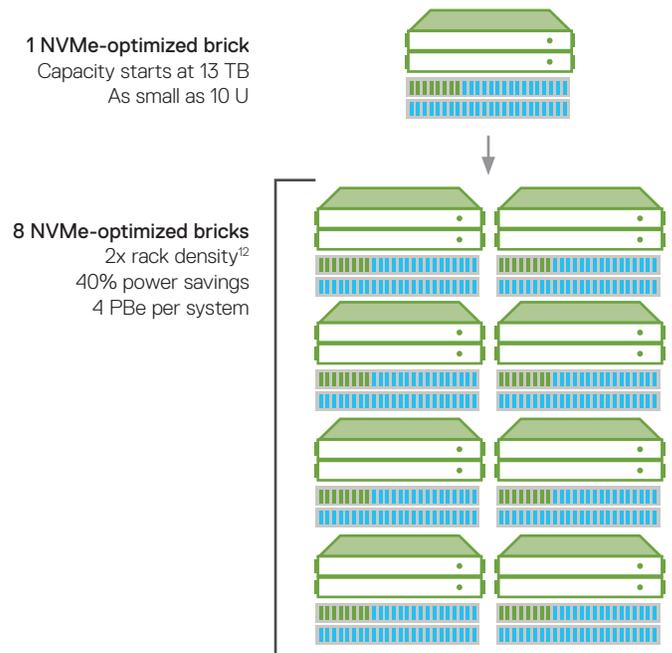


Figure 4. A multi-controller environment with multidimensional scale. The PowerMax array offers flexible scale-up and scale-out architecture. You can start with a single 10U brick with 13 TB of capacity and scale up to eight bricks—providing 4 petabytes (PB) of effective capacity in just two floor tiles.



DBAs to create and manage their own database copies to suit their requirements. Additionally, service levels can be assigned to meet performance requirements for each database copy. This helps to ensure that mission-critical applications like the primary EHR database operate at necessary performance levels at all times while preventing a single application or copy from getting more performance than it needs. In addition:

- Integrated copy data management, with SRDF software, supports replication of data across multiple sites or extended distances with simultaneous nonstop data access, while also complementing Caché mirroring and replicating of non-cached data with no additional infrastructure.
- Secure snaps with SnapVX keep snapshots safe by stopping any intentional or malicious deletion.

Scale up and scale out across the multi-controller environment

For healthcare organizations, the flexibility to scale on demand and do so cost-effectively means being able to meet existing clinical and research data demands while also responding quickly and efficiently as those demands change. Dell EMC PowerMax includes a multi-controller architecture with true multidimensional scale that supports expanded capacity and performance as needed without trapping data and creating islands of stranded capacity.

Systems can start small—with a single 10U brick and 13 TB of capacity—and scale all the way up to eight bricks and 4 petabytes (PB) of effective capacity in just two floor tiles (Figure 4).

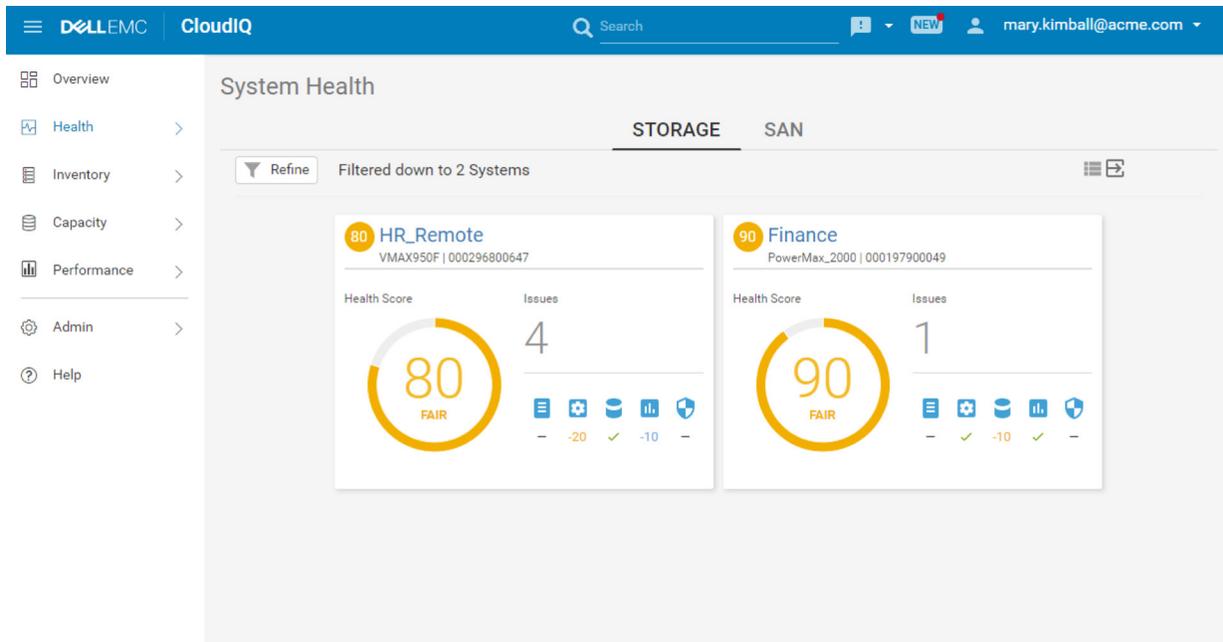
Moreover, PowerMax offers 40 percent lower power consumption and doubles the historical storage density, helping users lower costs and maximize resources by getting up to 2 PB of effective storage capacity in a single floor tile.

Simple management with trusted innovations

Easy to configure, deploy, and manage, PowerMax runs and maintains multiple production databases and third-party apps as well as copies for analytics, dev/test, backup, and go-live testing and more, including EHR databases to reporting databases like Oracle and SQL to virtualized applications like VMware vSphere and Windows Server Hyper V. Other management features include:

- The ability to consolidate block and file while running production and staging and performing development and testing
- The ability to consolidate mixed clinical and research workloads at the same time
- Simplified configuration management and provisioning—in under 30 seconds using a straightforward HTML5 interface
- Easy, expanded integration and reduction in the steps to automate daily tasks using full REST APIs
- Service levels that are built in using machine learning and matched to customer service levels (diamond, platinum, gold, silver, and bronze)—reference [PowerMax Service Levels for Epic Workloads](#)

Figure 5. CloudIQ Proactive Health Score. CloudIQ proactively monitors the critical areas of each PowerMax storage system to quickly identify potential issues and provide recommended remediations. The Health Score is a number ranging from 100 to 0, with 100 being a perfect Health Score. The Health Score is based upon five categories, including components, configuration, performance, capacity, and data protection.



CloudIQ: infrastructure insights right at your fingertips, from anywhere

Delivered with all Dell EMC PowerMax systems at no additional charge, CloudIQ is a cloud-native application that leverages machine learning to proactively monitor and measure the overall health of the complete storage environment with predictive analytics, root-cause investigation, and known-issue identification.

CloudIQ lets you easily monitor, analyze, and troubleshoot your Dell EMC PowerMax environment from anywhere—with no software to install, upgrade, or maintain. It's a single, simple platform that is available via your browser or mobile device (iOS or Android) to:

- Monitor storage health
- Report on historical storage trends
- Help plan for future storage growth
- Proactively discover issues and view recommended remediations

With CloudIQ, healthcare organizations ensure high uptime and optimized performance with simplified monitoring from an easy-to-use-and-access application featuring a single pane of glass to view the health of the entire storage infrastructure. For those with limited staff and budgets, this translates into significant time and cost savings.

CloudIQ uses an easy-to-understand health scoring system to identify and locate potential vulnerabilities in the storage

environment (Figure 5). These proactive health scores are based on each of these five categories:

1. Components
2. Configuration
3. Capacity
4. Performance
5. Data protection

To access CloudIQ, each organization logs in to its own secure, independent portal for visibility within its unique site ID. Multiple administrators can receive notifications and view their systems' status remotely—anytime, anywhere. Each user can see only those systems in CloudIQ which are part of that user's Site ID access as defined in the Dell EMC Service Center.

As CloudIQ is hosted on Dell EMC infrastructure, it is highly available and fault tolerant, and using Secure Remote Services, it provides sophisticated point-to-point encryption over a dedicated VPN, multifactor authentication, customer-controlled access policies, and RSA digital certificates to ensure that all your system data, statistics, and vitals are securely transported to Dell EMC.

Because CloudIQ is built on the cloud development platform Pivotal Cloud Foundry, updates are automatic through an agile-development cycle, ensuring zero interruption to daily operations and the security controls to enable modern application development using microservices. Healthcare organizations also accelerate time to value with no setup or installation required.

Figure 6. The PowerMax Family. PowerMax 2000 and PowerMax 8000 arrays are offered in appliance-based packaging that combines both hardware and one of two software packages—Essentials or Pro.

PowerMax 2000

- 1.7 M IOPS^{RRH-BK}
- 1 PBe Capacity
- 1 to 2 PowerBricks
- 64 FC/iSCSI Ports

PowerMax 8000

- 15 M IOPS^{RRH-BK}
- 4 PBe Capacity
- 1 to 8 PowerBricks
- 256 FC/FICON/iSCSI Ports



PowerMax Software		ESSENTIALS
SnapVX	Non-Disruptive Migration	QoS
Compression	Deduplication	iCDM Basic (AppSync)
PRO		
SRDF	eNAS	PowerPath
D@RE	iCDM Advanced (AppSync)	SRM

Advanced security to protect patient data

Dell EMC PowerMax provides the needed security to help protect patient data and address privacy requirements within the storage environment.

PowerMax is designed for FIPS 140-2 validation and meets the Advanced Encryption Standard (AES) 256 with data-at-rest encryption (D@RE)—protecting data at the drive level and easily integrating with external key managers.

Secure snaps with SnapVX keep snapshots safe by stopping any intentional or malicious deletion without any impact on performance.

Moreover, PowerMax enables backing up data directly to Dell EMC Data Domain with the help of Dell EMC PowerProtect Storage Direct technology, resulting in up to 20 times faster direct backups and 10 times faster recoveries. PowerProtect Storage Direct uses existing features of the PowerMax and Data Domain arrays to create backup copies and to restore backed-up data if necessary.

POWERING EHR WITH POWERMAX

Deploying and maintaining an EHR environment can be demanding. You need technologies that seamlessly address the workflow, management, and security needs associated with these workloads. PowerMax is a proven and trusted environment for any EHR system, offering the performance, availability, scalability, and innovation to meet the requirements of healthcare providers both today and well into the future.

Moving forward with confidence

PowerMax arrays are built for simplicity and include appliance-based packaging with either the Essentials or Pro software package—adding enhanced security, remote replication, eNAS, optimization, and management features (Figure 6). While all data services are available à la carte, healthcare

organizations can choose from these two simple appliance-based packages to best meet their needs:

1. The Essentials package offers local replication, embedded services, migration tools (NDM), and deduplication and compression.
2. The Pro package includes the above and adds remote replication (SRDF), path failover, D@RE, SRM, and AppSync iCDM advanced.

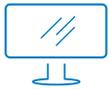
RecoverPoint (for heterogeneous replication) and PowerProtect Storage Direct (for the combined benefits of snapshots and backups) can be purchased and added separately.

Moreover, Dell EMC includes programs to future proof Dell EMC PowerMax investments. The Loyalty Program offers a set of world-class technology capabilities and programs that enable Dell EMC's storage products to provide value for the entire lifetime of a customer's applications. It is provided at no additional cost either in terms of higher maintenance price or higher product price. Clear Price affords predictable maintenance rates and includes additional services when a maintenance contract is renewed.

IT can further modernize the underlying infrastructure by incorporating PowerMax with a VxBlock 1000 system for all-in-one convergence that delivers 61 percent lower cost of operations, 52 percent less time spent on infrastructure management, and 99 percent less unplanned downtime.¹⁵ For those looking to extend the features of PowerMax and on-premises data centers to the public cloud, Dell EMC now offers Cloud Storage Services.



Find out more about how you can leverage modern infrastructure solutions like PowerMax and CloudIQ from Dell Technologies to increase the speed and efficiency of your clinical and business applications while cutting footprint, power, and management costs. Our automated, integrated approach to infrastructure means that you can secure patient data and better meet regulatory requirements while providing clinicians with uninterrupted access to EHRs and other mission-critical workloads—ultimately to improve patient outcomes, further innovation, and position your organization for what’s to come.



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1. Chronic Diseases Management Market Size is expected to grow at a CAGR of 17.5% By 2023 | Global Industry Share, Growth, Analysis, Forecast 2017-2023, Market Watch, Apr 1, 2019. <https://on.mktw.net/2FDUnTP>
2. Healthcare Industry Most Focused on Consolidation, Consumerism in 2019, Health Leaders, April 22, 2019. <http://bit.ly/2pUmJ7u>
3. Based on Dell EMC internal analysis of published bandwidth of the PowerMax 8000 versus competitive mainstream arrays, July 2019.
4. HIMSS Analytics, May 2019.
5. Epic Storage Products and Technology Status Document.
6. Based on Dell EMC internal analysis of PowerMax machine-learning analytics, July 2019.
7. Based on Dell EMC internal analysis of a single PowerMax 2000 or 8000 array, March 2018.
8. Based on Dell EMC internal analysis of random-read-hits max IOs per second (within a single array on two floor tiles) for the PowerMax 8000, March 2018.
9. Based on Dell EMC internal analysis of GBs per second (within a single array) for PowerMax 8000, July 2019.
10. Based on Dell EMC internal analysis of random-read-hits latency for PowerMax, July 2019.
11. IDC TechBrief: NVMe Over Fabric, Sep 2018, IDC TechBrief. Document #US43854018. <https://www.idc.com/getdoc.jsp?containerId=US43854018>
12. Based on Dell EMC internal analysis comparing maximum capacity per floor tile of the PowerMax 8000 against the VMAX 950F, March 2018.
13. Based on IDC white paper sponsored by Dell EMC, "The Business Value of Modernizing Mission-Critical Applications with Dell EMC VxBlock Systems, October 2017." Document #US43087517. Actual results may vary.

*Epic does not certify storage products or technologies. Instead, we provide feedback on storage products and technologies based on both results in the test lab and customer experience. The information we gather does not guarantee that a particular product or technology will or will not work. It is also important to note that lab testing and the size of our existing customer base is generally insufficient to be able to judge a technology or product as being reliable. However, in some cases, lab testing and design review can be used to judge a technology as unsuitable. In addition, we do not have data for all possible features that can be used in a given product, for example, SAN replication.

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