SOLUTIONS FOR HEALTHCARE: DELL EMC XTREMIO X2 STORAGE

Modernizing IT to drive clinical and business value from your Epic environment
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EXECUTIVE SUMMARY

Nearly ten years after the Patient Protection and Affordable Care Act (ACA), healthcare organizations in the U.S. continue to undergo rapid digital transformation in support of a variety of improvements, including enhanced care and extended patient services.

These drivers, and the ACA mandate itself, have heavily influenced the adoption of electronic health records (EHRs), with rates reaching nearly 87%. The scope of EHR platforms like Epic is expanding beyond patient records to accommodate value-based initiatives such as telehealth, connected health, 360-degree patient views, predictive analytics, and more.

The next big push is for EHR optimization through better patient data access and healthcare data interoperability across the care continuum, from primary care to acute care to home health. Digital technologies are converging to enable providers, administration, payers, and patients to share and access data in new and more powerful ways. Mobile and cloud-native healthcare applications are enabling on-the-go care like never before. Integrated medical devices running advanced analytics are leading to new breakthroughs, and an expanding network of medical IoT is enabling new remote and continuous patient monitoring.

However, in the midst of all this progress, health IT is being asked to manage the growing ecosystem of interconnected data, devices, and applications. Both healthcare staff and patients are demanding a seamless experience at the point of care, across the healthcare facility, and on the go with information delivered when and where needed.

Many health IT organizations are turning to virtualization to streamline IT management and address their application and information demands for anytime, anywhere access using any device. In fact, no other vertical is expected to undergo higher virtualization growth rates through 2025. But the complexity of managing the rapidly evolving IT ecosystem including virtual servers and desktops, multi-cloud services, and on-premises infrastructure is overwhelming the best of IT teams.

What’s needed, according to a recent ESG Lab Review, "lies in IT transformation" which they describe as "modernizing the infrastructure to deliver speed, scale, flexibility, efficiency, and cost-effectiveness, while keeping it user-oriented and customer-focused." While modernization should encompass the entire IT environment, there is an especially significant impact on storage. Deploying a modern, high-performance storage architecture will help to better support heavy-transaction healthcare application workloads, along with the following:

- Real-time data accessibility at the point of care and beyond
- Copy data-management processes for EHR databases without any interruption to 24x7x365 clinical operations
- Management of integrated storage environments, which often include a patchwork of systems, processes, and hardware
- Upgrades and migrations without any impact on daily operations or information flow
- Resiliency and security across the storage environment, as potential attack vectors increase and sophisticated attacks in healthcare escalate
- Consistent and reliable management of virtualized and multi-cloud environments (avoiding the I/O blender effect*)

Enter Dell EMC XtremIO X2, a purpose-built all-flash storage array offering both high performance and consistently low latency. With XtremIO X2, health IT can address its most critical operational imperatives while enabling clinicians, administration, finance, and other healthcare staff to gain immediate access to vital information to improve patient outcomes and make way for healthcare’s next big advancements.

Overcoming the I/O Blender Effect*

Virtualization in healthcare has provided many benefits, not the least of these being rapid, secure provisioning and management of clinical applications for anytime, anywhere access. However, a virtualized environment contains thousands of virtual machines (VMs), all performing random input/output (I/O) streams to a hypervisor for processing—often leading to a trade-off in application performance.

Dell EMC XtremIO X2 overcomes the I/O blender effect by integrating all-flash speed with rapid in-memory computation for consistent performance across the virtualized environment which is ideal for random, mixed workloads.
MODERNIZED STORAGE FOR BETTER, MORE EFFICIENT PATIENT CARE

Dell EMC XtremIO X2 helps keep clinicians focused on what truly matters most: patient health and outcomes. High storage efficiency with inline, all-the-time data services, rich application-integrated copy services, metadata-aware replication, and unprecedented management simplicity (Figures 1 and 2)—all at a low cost—are why health IT is turning to XtremIO X2. Features include:

- Consistent performance and high availability for Epic and other EHR systems, enabling real-time data accessibility at the point of care
- An optimized design for virtualized environments including client virtualization, VMware operations, and multi-cloud deployments—empowering the comprehensive clinical team with enhanced mobility and access to workloads when and where needed
- Optimized copy data management with simplified setup to harness the entire EHR workload life cycle without interrupting clinical operations or care delivery
- Superior data reduction to better manage the rapidly expanding healthcare data ecosystem
- Radically simple management and operation for reduced IT costs
- Easy scaling to cost-effectively grow over time and rapidly respond to the changing needs of healthcare
- No-compromise security to keep patient data safe and protected

Dell EMC XtremIO X2 for Epic

There are many advantages to using XtremIO X2 for Epic. X2 helps to improve end-user response times, allows batch jobs to run faster, simplifies the backup process, and allows you to allocate storage based on capacity requirements instead of IO requirements (Figure 3). In fact, Epic customers running X1 are choosing to upgrade to X2 because it delivers:

- Extreme performance, especially for virtual environments, with up to 25 percent faster boot times, two times faster VMware operations, and up to 80 percent better response time for VDI without compromising efficiency.
- Multi-dimensional scalability with four times denser X-Bricks.
- Unmatched storage efficiency with four to twenty times data reduction and two times more copies using inline deduplication, compression, XtremIO Virtual Copies (XVC), and thin provisioning.
- Dramatically lower TCO at about 33% fewer $/Gb.
- Consumer simplicity with enterprise capabilities from a unified HTML5 GUI with “smartphone app like” simplicity.
- An enterprise reference architecture for Epic based on optimal storage and backup and recovery configurations
to meet Epic’s strict availability and performance requirements. The reference architecture provides healthcare providers with the flexibility to select customized configurations that address their specific requirements.

Unparalleled consistent performance and high availability for real-time access to patient data

EHRs, ERPs, and other mission-critical healthcare applications are vital to patient care and diagnosis and must remain operational 24x7x365. Dell EMC XtremIO X2 incorporates industry-standard components and proprietary intelligent software to deliver the power and over 99.9999% of availability required to keep these workloads up and running, irrespective of the workload type, system load, and written capacity. Both latency and throughput remain consistently predictable and constant. This availability is particularly key for EHR databases like Epic, supporting analytics, VDI, and virtualized servers needing rapid response rates with zero compromise.

In fact, XtremIO X2 maintains sub-millisecond latency at 1.6 M IOPS—translating to continuous, uninterrupted access to vital patient data when and where needed and unimpeded productivity for every virtual clinical workspace user.

XtremIO X2 is a second generation all-flash storage array that was designed from the ground up to unlock flash’s full performance potential by uniquely leveraging characteristics of SSDs based on flash media. It provides high speed and low latency in an I/O pattern—which is especially effective for VDI and Epic workloads like the Caché database, which is read in an IO random pattern. However, XtremIO X2 is consistently performant across the environment, for all workloads, whether they leverage random read IO or cached IO and whether running production applications or database copies for test and development.

Because metadata-aware native replication with XtremIO X2 is built in, this helps to improve efficiencies without any need for manual management. More than 65% of Epic customers deploy Dell EMC solutions, including XtremIO X1, X2, VMAX, and PowerMax storage solutions.
for an external replication tool. This metadata-aware replication process is unlike anything else in the industry because it has been architected to send only compressed, unique data (after deduplication) to the remote site. This approach along with zero trimming and write-folding minimizes WAN bandwidth by up to 75 percent—helping to keep systems operational, clinicians productive, and patients safe.

**Ideal for virtualized and multi-cloud environments**

Today’s healthcare organizations are looking to virtual servers and desktops, private clouds, and hybrid clouds to increase infrastructure and management agility and efficiency at reduced costs. But if the supporting storage architecture is unable to deal with the complexity of the I/O blender effect—the random I/O patterns from VMs—this can lead to reduced performance and availability of needed clinical and business applications.

XtremIO X2 is designed to help manage the I/O blender effect from virtualized environments through scale-out, in-memory metadata and content-aware addressing, a unique fingerprinting approach that ensures that only unique blocks are written to the flash media (Figure 4). Doing so translates to maintaining the full performance potential of flash while maintaining consistency of performance for applications like EHR running in virtual environments.

Beyond managing the I/O blender effect, XtremIO X2 includes a variety of features to improve efficiencies for virtualization environments and cloud deployments, resulting in better overall performance in comparison to X1 (the previous version):

- Up to 80 percent better response time for VDI, with 20 percent more users in concurrent desktops
- Up to two times faster VMware operations
- Up to 40 GB/s bandwidth per X-Brick for VMware

**Optimized copy data management helps transform clinical and business application workflows**

The accumulation of data copies for mission-critical workloads like EHR is a direct result of ongoing testing and development, sandbox upgrade testing, integrity testing, data analytics, operations, and data protection. It’s typical for healthcare organizations to maintain upwards of 10 to 20 copies of their EHR database environment. But all these copies are putting a strain on storage capacity and management, and in many cases, they can interrupt clinical operations through system latencies. But with XtremIO X2, the production volumes and their copies all provide the exact same performance (Figure 5).

These space- and-memory-efficient snapshots, called XtremIO Virtual Copies (XVCs), leverage X2’s content-aware metadata-centric model. They are created quickly with no impact on the system and can be used just like a production volume with the same high performance. Both primary data and its associated copies are consolidated on to the same scale-out all-flash

**Figure 4. Content-Aware Addressing.** XtremIO X2 storage array processes data in blocks as it enters the storage controller. All incoming data streams are split into 16 KB blocks (X2) with each block receiving a unique fingerprint for all content based on the data content within the block. The fingerprinting methodology provides a uniform distribution of values. Even a single bit difference between any two 16 KB blocks will result in completely uncorrelated fingerprint values—resulting in optimized deduplication, storage, data movement, and replication processes.
array offering the agility to instantly restore or refresh from any parent to child snapshot or vice versa. This is known as integrated copy data management (iCDM) and was pioneered by the developers of XtremIO.

There’s no compromise in snapshotting all the data across the environment. XtremIO X2’s application-integrated copy services deliver near-real-time copies of production data sets. And these very high efficiency snapshots require no additional space, both at the memory/metadata layer and SSD physical capacity layer so there is no additional overhead and no interruptions to daily operations.

Using an automated, easy-to-use graphical orchestration tool, health IT can easily manage the entire healthcare application workload life cycle, including both primary patient data and all supporting database instances. And if needed, application owners and database administrators can be given access to enable self service for all of their copy needs. This level of service delivery automation enables health IT to simplify management while transforming clinical and business application workflows.

**Superior data efficiency to better meet healthcare’s big data demands**

With healthcare information multiplying and projected to increase at a compound annual growth rate (CAGR) of 36 percent through 2025, there is a pressing need for storage systems that can better manage the rapidly expanding healthcare data ecosystem. Dell EMC XtremIO X2 includes a variety of features for intelligent, system-wide data reduction and compression.

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**Figure 5. XtremIO X2 Virtual Copies (XVCs):** XtremIO X2 helps provision and deploy space-efficient, instant virtual data copies without impacting system performance.

**Figure 6. Inline deduplication and compression.** In this example, the system reduces the physical data written by the host by a 3:1 ratio by eliminating redundant blocks. Data compression further reduces the data by a 2:1 footprint by eliminating data redundancy within the binary level of each data block. Overall, the total data reduction ratio is 6:1.

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The XtremIO X2 inline data deduplication automatically removes duplicate I/O blocks from the data before it is written to the flash media. And global, dedupe-aware memory cache, which is aware of the deduplicated data, and content-based distribution inherently spread the data evenly across all available resources within a cluster (Figure 6). This enables scalable, global deduplication (over the entire system) in real time.

By limiting the amount of data written to flash, the system improves the longevity of the media and helps to drive down cost. It does this by allocating capacity to volumes on demand in granular data blocks. Volumes are always thin-provisioned without any loss of performance, over-provisioning of capacity, or fragmentation. As XtremIO has global inline deduplication, if a duplicate data block that exists anywhere in the XtremIO cluster is written, XtremIO will deduplicate the block in memory resulting in the data block not being written again. If a block is determined to be unique, the block is then compressed in memory before being written to the SSD media.

XtremIO X2’s use of inline, all-the-time data deduplication reduces data up to 5:1 (average data reduction of approximately 3.75:1) for compressible data and up to 10:1 for highly duplicated information, like virtual copies found in VDI. All volumes are accessible across all X-Bricks and across all storage-array host ports. This, in turn, helps to reduce the overall technology footprint, enables better performance due to reduced data, and increases overall endurance of the flash array’s SSDs.

**Multi-dimensional scale for true operational agility**

Dell EMC XtremIO X2 offers easy scaling to help healthcare organizations stay at the forefront of change by quickly and affordably growing over time. Further supporting cost efficiencies, provider organizations can introduce new patient services, like patient engagement EHR functionalities and telehealth, and expand capacity and performance as
needed at a more granular level. That means that there is never a need to overbuy—even in a rapidly increasing EHR environment.

XtremIO X2 accommodates complete multi-dimensional scale across the multi-controller environment (Figure 7). The result? Unlike many storage platforms that can scale up only for capacity but don’t scale out, XtremIO X2 can scale for both capacity and performance.

The system begins with a single building block, called an X-Brick with a minimum of 18 SSDs. As additional capacity is needed, it can scale up with up to 72 SSDs per X-Brick (Figure 6). The result is a decrease in TCO of nearly 33% fewer dollars per GB when compared to X1.3

XtremIO X2 also allows for linear expansions—ensuring that two X-Bricks can deliver twice the IOPS of a single X-Brick configuration, three X-Bricks deliver three times the amount, and so on. All the while, latency remains consistently low.

Radically simple management and operation

As administrative costs in healthcare continue to increase, health IT is being asked to do more with less. To help, XtremIO X2 boasts a platform so simple that no training is necessary to create and provision volumes. Moreover, the system includes:

- Highly automated processes, enabling application-consistent snapshotting using AppSync (Figure 8)—a graphical HTML5-based orchestration tool that allows copy data management and Epic environment refreshes with little to no scripting. It also simplifies and automates the process of creating and consuming XVC for iCDM use cases.
- In-memory metadata and content-aware addressing within X2’s architecture, which eliminates legacy SSD tasks such as log structuring and system-level garbage collection.
- The XtremIO Management Server for non-disruptive upgrades and migration with no interruption to daily operations.

No-compromise security to safeguard patient information across the IT ecosystem

Maintaining good security hygiene includes protecting data where it resides. This is vital to keeping electronic personal health information (ePHI) safe while helping to address key privacy requirements outlined in HIPAA, HITECH, and GDPR.

XtremIO X2 includes comprehensive data security spanning inside the array with data-at-rest encryption (D@RE) and XtremIO snapshots with near-zero RTO; in the data center with ProtectPoint integration; and across data centers with a metadata-centric architecture.

XtremIO X2 enables D@RE through the use of self-encrypting drive (SED) technology—containing dedicated hardware
to encrypt and decrypt data as it is written to or read from the SSD. Offloading the encryption task to the SSD enables XtremIO X2 to maintain the same software architecture whenever encryption is enabled or disabled on the array with no performance penalty.

XtremIO X2’s proprietary flash-optimized algorithm known as XtremIO Data Protection (XDP) is superior to any existing RAID algorithm in being able to secure patient data stored on the array by requiring much lower capacity overhead than any other RAID technique.

Daily backups of mission-critical databases are especially critical for healthcare organizations who face heightened cybersecurity threats. By integrating XtremIO X2 primary storage with the protection storage, Dell EMC ProtectPoint reduces cost and complexity, increases speed, and maintains recoverability of backups. ProtectPoint is a data-protection offering which brings the benefits of snapshots together with the benefits of backups, enabling incremental-only backup directly from XtremIO X2 to the backup media without needing to go through an orchestrator. In fact, ProtectPoint for XtremIO X2 enables organizations to perform nightly, full (non-incremental) backups of their production databases like Epic Caché in a matter of one to two hours versus traditional backups, which can take anywhere between 12 to 24 hours.

**GETTING STARTED WITH X2**

When it comes to storage, Dell EMC XtremIO X2 is a proven and trusted environment for patients, clinicians, doctors, and IT alike. Healthcare organizations can quickly realize time to value of their EHR and virtual environments with easy-to-deploy configurations, validated reference architectures, and a dedicated Dell Technologies global account team versed in health IT implementations and management. This three-pronged approach delivers new levels of efficiency, agility, and performance while reducing risk.

**Position your healthcare organization to be future-ready**

The Dell Technologies Future-Proof Loyalty Program provides health IT with additional peace of mind with guaranteed satisfaction and investment protection for future technology changes. The program offers a set of world-class technology capabilities and programs that enable Dell Technologies storage solutions to provide value for the entire lifetime of a customer’s applications. It is provided at no additional cost either in terms of a higher maintenance price or higher product price.

**Position your healthcare organization to be cloud-ready**

Cloud is fast becoming the norm in healthcare. In fact, according to a recent HIMSS survey, organizations will have roughly half of their workloads deployed in the cloud by the end of the year. In order to take advantage of all cloud has to offer, health IT needs to ensure that on-premises infrastructure is built to support a multi-cloud-ready framework—one that enables provisioning, monitoring, managing, securing, and moving clinical and business workloads back and forth among different types of clouds. Dell Technologies Cloud powered by VMware combines the needed compute, storage (XtremIO X2), networking, and data protection in a pre-engineered, fully integrated package to be ready to run as the operational hub of a multi-cloud environment.
Find out more about how you can leverage modern infrastructure solutions like XtremIO X2 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.

3. Based on Dell EMC internal testing, February 2017
4. HIMSS Analytics, October 2018
5. As specified in the customer’s Hardware Configuration Guide from Epic

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