SOLUTIONS FOR A VIRTUALIZED EPIC EHR ENVIRONMENT

As healthcare organizations prepare for Meaningful Use Level 2 and look ahead to MU Level 3 and the advent of Accountable Care, many are investing in Epic EHR to provide them with a “single view” of the patient, a foundation for evidence-based-decision support, quality management, and outcomes reporting. Epic has proven its ability to transform healthcare delivery, increase efficiency, and improve patient care. An indication of this is the fact that today roughly seven of every ten HIMSS Stage 7 hospitals are running EpicCare.

Yet healthcare IT departments, facing rising costs and continuing healthcare regulatory reforms, are hamstrung by limited staff and budget, struggle to keep up, often exhausting resources. Gartner estimates that nearly 80% of IT spending is directed at simply trying to “keep the lights on” by respond to changing business requests instead of redefining their data center. This flawed IT model will not adequately support the deployment of new initiatives like deploying an EMR, not to mention demands for improved efficiencies, consolidation of resources, overall cost reductions, better security, governance, and compliance, and more.

Redefining their healthcare data center would require IT organizations that can quickly bring quality healthcare products and services to market, improve customer engagement and patient experience within their institutions, anticipate and quickly adapt to new regulations or operating requirements, and respond to negative events. McKinsey & Company, the leading global management-consulting firm, calls this new model “business agility” — the ability of an organization to adapt rapidly and cost-efficiently to changes in its environment. Agile organizations do much more with less—an imperative for healthcare organizations today.
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EMC was the first vendor to test the following technologies in an Epic environment:

- Tiering with the Caché database in production
- FAST VP with non-production workloads
- FAST VP with EFDs in production

As a result of EMC innovation and investments in engineering labs and technical staff who understand Epic software and deployment, more than 60 percent of Epic North American environments run on EMC infrastructure today.

### NEXT GENERATION OF HEALTH IT

Organizations across the healthcare spectrum are looking to cloud computing, a dynamic, secure and compliant solution that dramatically reduces IT services-delivery time in order to increase business agility, to break this cycle and unlock resources to fuel more innovations. Healthcare organizations are no longer asking whether they should deploy and leverage virtualization and cloud computing models, but how and how fast can they deliver Epic via flexible cloud-based services throughout their organization.

This transformation would extend from the datacenter to the desktop, but also reaches beyond the four walls of a single hospital to manage collaboration and consolidation from hospital mergers and health network acquisitions. This would include alliances with specialty clinics and labs, even managing software upgrades and migrations across multiple sites. The end result of this transformation yields not only the high performance and availability demanded by your Epic application and your caregivers, but also an overall reduction in your IT complexity and risk, and an increase in your IT efficiencies.

This EMC Perspective describes how EMC, the global leader global leader in IT and business transformation, VMware, the global leader virtualization software, and Epic, the world leader in virtualization software for healthcare organizations of all sizes, are working together to provide solutions for healthcare IT. These solutions provide the foundation to meet current service requirements, and accelerate your journey to cloud computing and deliver Epic-as-a-Service throughout your healthcare enterprise. They also enable Health IT to play a major role in creating an agile healthcare organization, ready to face new challenges as they arise.

### HEALTH IT IS OUR BUSINESS

EMC, VMware, and Epic work together to test and deliver innovative and integrated solutions that help make Epic environments more agile, efficient, and secure, and to deliver higher availability and performance. EMC has tested advanced backup and recovery solutions with Epic and has deployed these solutions in more than 100 Epic sites in North America. No one else has developed and tested more point of integration with VMware than EMC.

The VMware platform is the most extensively installed virtualization platform worldwide. VMware and Epic have successfully virtualized Epic applications running on Windows Servers using VSphere. Customer adoption led to Epic using VSphere to virtualize the InterSystems Caché database engine running on Linux. VMware VSphere as a “Target Platform” supporting the deployment of Windows servers and services, including Haiku, Epic Web, Print Services and MyChart.

VMware Horizon View achieved “Target Platform” status for Epic EMR delivery through a virtual clinical desktop, becoming the first virtual desktop infrastructure solution to receive this status. As VMware helps customers bridge to this new world and lays the foundation for the build out of the software-defined data center, it is enabling them to achieve new levels of efficiency, control and agility.

### YOUR FOUNDATION FOR CLOUD COMPUTING

The VMware platform is the most extensively installed virtualization platform worldwide. VMware and Epic have successfully virtualized Epic applications running on Windows Servers using VSphere. Customer adoption led to Epic using VSphere to virtualize the InterSystems Caché database engine running on Linux. VMware VSphere as a “Target Platform” supporting the deployment of Windows servers and services, including Haiku, Epic Web, Print Services and MyChart.
The healthcare industry’s first end-to-end cloud computing platform, depicted in Figure 1 above, the vCloud for Healthcare solution, enables healthcare organizations to exchange information and deliver secure, agile and reliable patient care products and services. Building on the foundation of vCloud for Healthcare, healthcare organizations can move more confidently into cloud computing and more easily address requirements for Stage 2 and Stage 3 of Meaningful Use, while providing the necessary control and transparency for regulated organizations to meet and maintain compliance mandates. To provide a true end-to-end care cloud platform, VMware vCloud for Healthcare brings together the capabilities of products within VMware Horizon Suite and VMware vCloud Suite that healthcare customers need in order to architect an agile, reliable, private, public, or hybrid cloud.

**REDEFINE YOUR EPIC STORAGE AS CLOUD READY**

EMC VMAX Cloud Edition is the first self-service, enterprise class-storage delivery platform that accelerates time-to-value for Epic users’ private, hybrid, and public clouds. VMAX combines the foundation for six 9s of high availability and resiliency that Epic EHR environments demand with the immediate access and flexibility of self-service. VMAX Cloud Edition also delivers automatic provisioning, trusted multi-tenancy, built-in metering and chargeback reporting.

VMAX comes with built-in support for external servers using RSA® Data Protection Manager for data-at-rest encryption (D@RE). This includes key management for maximum flexibility in securing data at the drive-level, both capabilities helpful in addressing HIPAA and HITECH regulations.

VMAX also enables the consolidation of front-end global memory and back-end functions, enabling direct memory access to data for optimized I/O operations. This is an ideal design for the Epic production environment and its 80-second write cycle. Dynamic cache partitioning for VMAX allows Epic users to prioritize I/O’s so the production database delivers a consistent performance.

Many healthcare organizations have already taken an important first step toward cloud computing by virtualizing and standardizing their IT infrastructure. With the help of Healthcare ISVs like Epic along with medical imaging vendors, healthcare IT Managers and CIOs are accelerating their adoption of virtualization and cloud computing to help power their most critical patient-care systems. EMC can help.
EMC SOLUTIONS FOR EPIC EMR
ADVANCED BACKUP AND RECOVERY IN VIRTUALIZED EPIC ENVIRONMENTS

Fast, reliable backup and recovery of virtualized Epic applications and data are essential to complying with strict HIPAA and HITECH regulations and achieving meaningful use. Given the large size of Epic databases and unique characteristics of Epic’s diverse data streams, establishing acceptable backup and recovery service levels is challenging for many healthcare organizations. The complexity and poor reliability of many existing solutions also make it difficult to frequently test backup and recovery as required by HIPAA.

To address these needs, EMC offers an integrated suite of data protection software and backup hardware solutions that deliver high performance, extensive scalability, and rock-solid reliability for virtualized Epic environments (Figure 2).

**Figure 2. EMC Reference Architecture for Backup and Recovery of Virtualized Epic Environments**

EMC DATA PROTECTION SOFTWARE

EMC’s data protection software is tightly integrated with VMware to streamline backup and recovery operations in highly virtualized environments. The software centralizes, automates, and accelerates data backup and recovery across your Epic environment. It also includes client-side deduplication, which can reduce the amount of data being backed up by as much as 99 percent, dramatically improving backup performance. Recovery is fast and easy, invoked in a single step.

For protecting Epic services running on VMware virtual machines (VMs), EMC embeds Avamar deduplication software in the VMware ESX Server, as well as the VMware vStorage API for Data Protection (VADP) toolset. This enables you to easily perform guest- or image-level backups from your VMware virtualized Epic environment.
“Running applications on ESX ensures their reliability, which is the number-one reason we began adopting it across the board in our datacenter. So many of our applications and systems are absolutely vital to staff and patients. So making sure they’re available whenever they’re needed is our paramount concern.”

— Tim Harper, Senior Systems Analyst
Kadlec Medical Center

EMC DATA DOMAIN BACKUP STORAGE

The hardware foundation for protecting virtualized Epic environments is EMC Data Domain® deduplication storage systems. Data Domain provides a single backup storage system for the full range of Epic data streams, delivering the speed, capacity, and resilience to fully protect clinical, financial, and administrative information.

The Data Domain data invulnerability architecture (DIA) enables the system to protect billions of blocks of data without loss or corruption while maintaining high performance to meet service-level agreements (SLAs). Data Domain also deduplicates data in-memory before writing to disk, optimizing system utilization without impacting backup performance.

With stringent HIPAA security rules, data encryption has become especially important in virtualized Epic environments. Data Domain encryption software seamlessly integrates with the deduplication process to encrypt data “in flight” before it is written to disk, maximizing efficiency and security. Once written to the Data Domain system, data remains encrypted at rest, preventing it from being accessed without proper authentication. Plus, if the Data Domain system is replicated to a remote site for disaster protection, the data remains encrypted and secure.

BACKUP AND RECOVERY STRATEGIES FOR DIVERSE EPIC DATA SOURCES

Epic environments are comprised of a variety of data sources, each presenting a unique challenge for backup and recovery. By using EMC’s integrated software and hardware solutions, EMC has developed a set of data protection strategies that address these challenges for all of the major Epic components—Caché database, Clarity reporting database, Cogito data warehouse, binary large object (BLOB) data, and VMware virtual machines (VMs).

Caché database

Epic requires that Caché database, Epic’s most important data source, to be protected with Caché shadowing. This involves creating a clone of the database, which presents itself for backup as a file system containing eight to 32 directories and thousands of very large files.

While such an environment might cripple some backup solutions, EMC data protection software is designed to back up the Caché database from the clone to Data Domain, taking full advantage of the speed, efficiency, and scalability that Data Domain provides. EMC data protection software and Data Domain also enable very fast restores of the Caché database.

Clarity and Cogito databases

Clarity and Cogito databases are built on Microsoft SQL Server or Oracle Database architectures, and can be as large as 30 terabytes. Traditionally, backups required pausing the Epic database—temporarily rendering it inactive—to move data onto a backup server. This disrupts production operations and reduces response times and availability for users during backup processes.

By contrast, EMC has incorporated data protection software with native database application tools to eliminate this problem. For example, EMC Data Domain Boost software integrates EMC data protection software with Oracle RMAN for backing up Oracle-based Clarity or Cogito databases directly to Data Domain without any need for a separate backup server. This approach extends deduplication to RMAN, accelerating Oracle database backups by more than 50 percent. It also eliminates the cost of expensive database modules that may be required with traditional backup software.
BLOB data

BLOB data typically includes scanned images, logos, and "smart text" that physicians use for note taking, and patient photos for positive identification. This information is updated frequently and often must be retained for extended periods.

When BLOB data is virtualized with VMware, EMC data protection software takes advantage of Changed Block Tracking. This is a feature of VMware vStorage APIs for Data Protection (VADP) that allows you to back up only the data blocks that have changed since the last backup. This results in much faster backups of BLOB data. In addition, the software also uses Changed Block Tracking for fast restores.

For BLOB data with long retention periods, EMC recommends that data be archived and removed from the backup cycle.

VMware environment

EMC stands out in the industry for the deep integration between EMC and VMware technologies. By embedding EMC’s data protection software with VADP and employing Changed Block Tracking, EMC accelerates backups of all VMware VMs in the Epic environment.

Thanks to this integration, EMC data protection software also is aware of the current state of the VM and can determine which blocks from the last backup are needed in a restore scenario. This reduces the time to restore full VMs or individual files from hours to minutes keeping patient data highly available to your caregivers.

In addition, EMC data protection software offers VM Instant Access, which allows a VM backed up on Data Domain to run directly from the backup within seconds. While the VM is running from backup, the data protection software does not overwrite the original backup image. Any new data is backed up to a separate file. When the production environment is stabilized, the live VM can then be moved from backup to production using VMware vMotion, eliminating disruption to Epic users.

MANAGING YOUR EPIC BACKUP ENVIRONMENT

EMC also simplifies administration of backup and recovery for virtualized Epic environments. By integrating EMC’s data protection software with VMware vCenter Operations Manager (vCOPs), administrators have a single pane of glass through vCenter to initialize and monitor backups, as well as invoke recoveries as needed.

By taking a holistic approach to backup and recovery for virtualized Epic environments, EMC enables you to streamline the entire process, reducing time and cost while maximizing protection of critical Epic data. In addition, an integrated EMC solution simplifies backup and recovery testing to meet HIPAA and meaningful use requirements without disrupting production operations.
SITE-TO-SITE FAILOVER

Epic defines specific methods for ensuring disaster recovery (DR) and business continuity across all data sources. For components within Epic that are typically virtualized, EMC offers advanced site-to-site failover solutions tightly integrated with VMware tools to optimize performance and efficiency of the failover process (Figure 3).

Figure 3: EMC Reference Architecture for Site-to-Site Failover of Virtualized Epic Environments

Caché and Clarity databases, which Epic approves for virtualization, can use a combination of VMware VMotion and VMware High Availability (HA) to move VMs from one physical host to another. VMotion allows live migration of VMs between physical hosts without disrupting production operations, which is ideal for maintaining high availability during planned downtime such as server maintenance. VMware HA helps prevent unplanned host failure by automatically restarting VMs on another physical server.

While the VMs running Caché and Clarity can be protected with VMotion and VMware HA, Epic requires protecting data associated with the Caché database with Caché shadowing.

For full site-to-site failover of VMs running Caché and Clarity, as well as the underlying storage supporting these databases, EMC offers VMware vCenter Site Recovery Manager (SRM) combined with a choice of EMC array-based replication solutions, including RecoverPoint®, SRDF®, and MirrorView™.

Tightly integrated with the EMC replication solutions, SRM orchestrates the failover of VMs and associated storage supporting the Caché or Clarity environments to a consistent point in time at a disaster recovery site. SRM also automates failback processes once the production site is stabilized. Because the failover and failback occur without disrupting production operations, you can easily test your DR plan to ensure compliance with HIPAA and meaningful use.
CONTINUOUS AVAILABILITY

For seamless business continuity of non-production virtualized Epic data sources, healthcare providers can use EMC VPLEX®, which enables mobility and continuous availability across geographically separated sites.

VPLEX ensures business continuity of virtualized Epic service servers, including BLOB, Business Objects, Care Everywhere, print and web servers, communication servers, and system monitoring servers. Through distributed federation of physical resources, VPLEX enables these virtualized Epic service servers to be accessible from two separate data centers simultaneously. If services are lost at one data center, they automatically continue to run from the other data center without any disruption to Epic users.

By using VMware SRM with VPLEX, you can create a coordinated plan to prioritize the VMs that fail over operations to the secondary site and those operations that are suspended during an outage. SRM also automates the entire VM failover process, eliminating the need for manual intervention.

You can also deploy VMotion with VPLEX to move live VMs from one physical host to another at the remote site. This provides added flexibility to avoid downtime during planned maintenance or upgrades at the primary site. Since VPLEX maintains a virtual copy of data at both sites, there is no need to fail over storage when moving VMs with VMotion. Tight links between EMC storage and VMware vCenter make it easy to map VMs to the VPLEX virtualized storage.

Adding EMC RecoverPoint® to the VPLEX environment ensures continuous data protection for Epic service servers by providing digital video recorder (DVR) capabilities that capture and play back data to a specific point in time.

With this integrated, virtualized, and geographically separated environment, you can achieve a recovery time objective (RTO) of zero while approaching a recovery point objective (RPO) of zero for assured business continuity of Epic service servers.

EPIC COMMUNITY CONNECT

Large healthcare organizations are deploying the cloud-based Epic Community Connect solution to extend Epic electronic medical record (EMR) solutions to independent physician practices and community hospitals.

Operating as an “Epic-as-a-service” model, Community Connect allows participating healthcare organizations to share clinical data and patient records using a centralized Epic infrastructure maintained by the host healthcare organization, which acts as a service provider. Patients can also manage their health records using Epic’s MyChart web portal through Community Connect.

Community Connect requires the performance, scalability, and reliability of EMC storage, data protection, disaster recovery, and business continuity solutions to ensure around-the-clock availability of Epic EMR in the cloud. User access to the EMR is enabled through virtual desktops created with VMware Horizon View or Citrix XenDesktop.

Service providers of Community Connect also have the option of deploying VCE Vblock Systems, described in the next section of this document, which integrate EMC storage, EMC data protection, VMware and Cisco UCS and networking, as a complete virtualized infrastructure. Vblock systems, which have been pre-integrated, tested, and validated, provide service providers with fast and easy deployment and scalability as additional healthcare organizations join the network.
With Community Connect built on robust EMC and VMware solutions, small healthcare organizations with limited resources gain world-class EMR capabilities, often at a lower cost than building their own EMR, and without the need for technical staff to manage the infrastructure. At the same time, larger providers invest in their infrastructure and extend the benefits of Epic EMR resources across a larger community of clinicians and patients.

**INTEGRATED AND VIRTUALIZED EPIC DESKTOP ENVIRONMENTS**

The advent of digitized medical records software like Epic has dramatically reduced the amount of paper-based patient records and has brought quick access to patient information by caregivers, resulting in better clinical outcomes. However, the removal of this “paper safety net” also increases risk if clinical applications in the datacenter go down. For this reason, desktops and patient care applications are being modernized to become immediately accessible and available to caregivers, even in the event of site failures and outages.

To achieve this, virtualization benefits are being extended to the point of care in hospitals everywhere. Virtual Desktop Infrastructure (VDI) solutions provide secure and mobile access to patient-care systems, enabling clinicians and caregivers to securely access patient data from a variety of devices either within the hospital setting or remotely, if need be.

The EMC Solution for Managing Epic Virtual Desktop Environments integrates EMC technologies with those from VMware, VCE, and other partners to deliver an end-to-end “always on” and secure desktop environment for Epic users. VMware vSphere Desktop suite of software is a highly scalable, reliable and robust platform for running virtual desktops and applications. This suite includes built-in business-continuity and disaster-recovery capabilities to protect desktop data and availability without the cost and complexity of traditional solutions.

vSphere Desktop also includes software that offloads and centralizes antivirus and antimalware (AV) solutions, eliminating “agent sprawl” and “AV storm” issues while minimizing risk of malware infection. Finally, vSphere Desktop software acts as a central management hub for vSphere—giving you complete control over and visibility into clusters, hosts, virtual machines, storage, networking and other critical elements of your virtual Epic infrastructure.

VMware Horizon View is a tightly integrated with on VMware vSphere, and extends business continuity and disaster recovery features to their desktops, standardizing on a common platform, from the desktop through the datacenter—to the cloud.

A large number of healthcare organizations have taken steps to implement Epic but are struggling to manage distributed endpoints such as desktops, laptops, tablets and smartphones used by caregivers and administrative staff. For these organizations VMware Horizon View allows unified access to virtual desktops for both clinical and business applications to run in a secure, centralized datacenter accessible from a wide variety of devices, such as PCs, thin clients, zero clients, iPads, and other tablets.

Horizon View moves desktops and applications into the cloud and delivers them as a highly available managed service, allowing IT to manage desktops, Epic applications, and patient data centrally while increasing flexibility and customization for the end-user.
This architecture for this solution is depicted in Figure 4 below and delivered on a Vblock Specialized System for Extreme Applications is specifically designed for solutions like VDI. Vblock Systems seamlessly integrate leading compute, network, and storage technologies, providing at-scale virtualization and application performance.

Figure 4. Integrated and Virtualized Desktop Environments
With VMware View, our physicians don’t just have access to lab reports. They can see actual X-ray images, access emergency department records and even monitor biofeedback if a patient’s in a critical care situation. All the applications they need are right there at their fingertips, giving them a more global picture of their patients than ever before.”

— Michael LaForge, Network Administrator, Columbia Memorial Hospital

XtremIO, a highly scalable, all-flash storage array, combines multi-level cell (MLC) flash with sophisticated wear leveling, data reduction, and write abatement technology. This delivers extended flash endurance that makes the system both enterprise-reliable for Epic environments and also cost effective. XtremIO delivers 99.9999 per cent (six nines) field-proven availability, which calculates to less than 32 Seconds of unavailability in a year, and less than 3 minutes of unavailability over the lifetime of the product.

In this Epic desktop solution, user data and Horizon View personal data are directed to EMC Isilon NAS storage. Adding Isilon storage for user data provides a simple, low-cost, file-based solution with scale-out design. Sending user data to Isilon NAS and the data from virtual desktops to XtremIO SAN increases desktop footprint capacity and value per desktop. It also improves Epic users’ experience by separating storage I/O workloads by directing them to different storage platforms. This solution also provides single-sign-on (SSO), strong authentication, and utilizes a less invasive and lighter weight provisioning approach that enables rapid application on-boarding, permitting users to access quickly all workstations and application they are authorized to use. In the event of a site failover, desktop agents can continuously look up the next working instance without disrupting Epic workflow because multiple instances of virtual appliances are configured and linked at both sites with fault tolerance.

- **End-user Computing Services** accelerate the move to VDI using technologies like VMware Horizon View, Single Sign On, and other security tools and app residency services fills resource and skills gaps by adding experts by adding experts to your IT staff to optimize day-to-day operations and accelerate adoption of new technologies

**REDEFINING TRUSTED HEALTH IT**

Health IT is what EMC does. As a result we have been extremely successful in delivering Epic IT infrastructure that satisfies both the demands of the Epic application and the demands of Epic users for instant and continuous access to patient data by authorized users. We are redefining trusted health IT with our Epic customers at nine of the ten largest Epic installs in the U.S. Nobody had developed and tested more points of integration with VMware than EMC.

You can trust EMC, working with VMware, and our partners to deliver continuous innovation for your Epic EHR, your other clinical applications, and all of your enterprise IT infrastructure.

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