CERNER EMR: OPTIMIZING IT INFRASTRUCTURES

Guidance for maximizing performance, availability and mobility of Cerner Millennium environments

ABSTRACT

Cerner Millennium EMR plays a critical role in delivering quality patient care and maintaining efficient operations. This white paper presents best practice recommendations from EMC® for planning and designing an IT infrastructure that delivers the high performance, availability and mobility demanded by Cerner EMR environments.

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EXECUTIVE SUMMARY

Cerner Millennium electronic medical record (EMR) is at the heart of major healthcare systems around the world. It is essential for complying with requirements of the Affordable Care Act and HIPAA, as well as demonstrating meaningful use according to provisions if the HITECH act.

Because the Cerner EMR plays a key role in ensuring efficient, quality patient care, its underlying Oracle database and Millennium applications require the highest levels of performance and availability. In addition, clinicians today are constantly on the move, requiring anywhere/anytime access to the EMR.

Most legacy IT infrastructures are not optimized to handle the demands of large EMR environments like Cerner Millennium. Planning and configuring the storage infrastructure requires close attention to the unique requirements of Oracle databases. Specialized solutions are often also required to ensure continuous availability of Cerner Millennium in an around-the-clock hospital environment. In addition, IT infrastructures must be designed to manage the rapid proliferation of virtualized desktops among clinicians seeking greater mobility.

This white paper provides detailed guidance for ensuring performance, availability, mobility, and data protection of Cerner Millennium. Drawing from EMC’s extensive Oracle and storage expertise and close working relationship with Cerner, this white paper will help healthcare providers maximize the value of Cerner Millennium with enhanced patient care and improved operational efficiency.
INTRODUCTION

As provisions of the Affordable Care Act (ACA) come into effect, healthcare providers face an overwhelming need to improve accountability of care and administrative efficiency. The best way to achieve these objectives is by deploying a paperless system that provides clinicians and administrators with anywhere, anytime access to a common set of patient records and medical information. That’s why many healthcare organizations, from large integrated delivery networks (IDNs) to local community hospitals, rely on the Cerner Millennium electronic medical record (EMR) solution.

Cerner Millennium provides a common Oracle database supporting a suite of integrated applications for everything from patient charting and bedside monitoring to radiology, lab, and pharmacy management. This comprehensive solution enables healthcare organizations to streamline operations and meet the demands of the ACA, “meaningful use” and HIPAA compliance.

Implementing Cerner Millennium comes with a set of IT challenges. Legacy IT infrastructures can buckle under the strain of handling huge volumes of information generated by Cerner Millennium environments. This can compromise performance, slowing access to vital patient records, diagnostics, and medical information. Clinicians also are constantly on the move, often from one facility to another. Yet many legacy infrastructures are not optimized for mobile access to the EMR. And periodic downtime, typically due to administrator intervention in these complex environments, can have devastating effects on delivering patient care.

Another common IT challenge is creating a highly responsive reporting environment to assist in complying with ACA and meaningful use requirements. Traditionally, healthcare providers would generate reports by creating direct copies or clones of the production Oracle database to avoid performance issues. The issue was that this process creates a full copy of the database, requiring additional storage space at a significant cost.

Addressing these challenges, EMC provides Cerner customers with a comprehensive portfolio of storage, data mobility, high availability and data protection solutions and services that maximize the value of Millennium across their healthcare enterprises.
CERNER AND EMC RELATIONSHIP

EMC has worked closely with Cerner for years, combining a wealth of healthcare expertise with advanced technology solutions to enable healthcare providers improve their responsiveness to patient needs, protect vital medical information, and drive efficiency across the full continuum of patient care.

Based on a longstanding, successful relationship with Cerner and deep collaboration with Oracle, EMC has developed a comprehensive reference architecture for Cerner Millennium (Figure 1). Using this architecture, EMC can help providers confidently deploy and manage their Millennium environments from the desktop to the data center and seamlessly across geographically separated data centers.

![Figure 1 - EMC Reference Architecture for Cerner](image)

Key solutions used within this reference architecture include:

**Storage**

- **EMC VMAX®** enterprise storage for extremely high performance and six-nines availability
- **EMC VNX®** unified storage for efficient multi-protocol file and block storage with five-nines availability
- **EMC FAST™ VP** (Fully Automated Storage Tiering for Virtual Pools) and **FAST Suite** for optimizing storage performance and utilization
- **EMC XtremIO™** all-flash scale-out enterprise storage to maximize I/O performance

**Converged Infrastructure**

- **Vblock Systems** providing a pre-integrated server, storage and networking infrastructure for rapid deployment of virtualized environments
Virtualization

• VMware vSphere hypervisor for server virtualization
• VMware Horizon View for virtualized end-user computing

High Availability and Data Mobility

• EMC VPLEX® virtual storage for continuous application and data availability within and across data centers

Backup and Recovery

• EMC Data Domain® deduplication storage systems and Data Domain Boost® used with Oracle RMAN for backup of large Oracle databases
• EMC Avamar® deduplication backup software and system for daily full backups

To tailor infrastructures for individual providers, EMC has developed sizing and configuration tools. Drawing from its Oracle expertise garnered from extensive joint EMC-Oracle engineering and testing, EMC developed these tools to integrate optimized Oracle configurations with Cerner-specific sizing algorithms. As a result, healthcare providers can deploy EMC solutions for their Millennium environments with confidence that they will meet everyday demands for performance, mobility, and availability.

In addition, EMC conducts extensive field validations of EMC solutions in production Millennium environments. Using Cerner’s Lights On Network tool, EMC performs a range of performance benchmarks and compares the results to other Cerner implementations. These metrics confirm for Cerner customers the value of running Millennium on EMC infrastructures.

EMC customer support is also closely aligned with Cerner. Customers have a direct line to EMC for prompt diagnostics and repair for any aspect of the EMC infrastructure. If an issue extends further into the Millennium environment, EMC can quickly bring in resources from Cerner or Oracle and work collaboratively to resolve the problem.
STORAGE INFRASTRUCTURE

Performance Considerations

Based on EMC's experience, one of the biggest storage challenges facing Cerner customers is performance. Whether accessing charts or running lab reports, response time is critical when patient care is at stake. EMC VMAX enterprise storage or EMC VNX unified storage provide important performance advantages for Cerner Millennium, particularly when EMC FAST VP or FAST Suite are used in a tiered configuration with flash and higher-capacity drives (Figure 2).

For example, when FAST VP and FAST Cache—a key component of EMC's FAST Suite—are combined, Oracle performance improved up to 150 percent while enabling three times additional users to be supported on the same storage platform.\(^1\)

University of Illinois Hospital and Health Science System (UI Health), has reported similar improvements. UI Health's enterprise storage administrator, Roger Lyon, stated, "FAST VP alone reduced Cerner EMR response times from 15 milliseconds to about five. When we implemented FAST Cache, response times dropped again to just two milliseconds. The performance is just out of this world."

Tom Perrone, UI Health’s Systems Analyst, added, "Lab reports that used to take 90 minutes now run in 10 minutes. Performance is very consistent even during I/O bursts, which used to spike response times up to 15 to 20 milliseconds. FAST Cache completely eliminated that issue."

Optimizing Virtualized Environments

For providers looking to virtualize their Oracle-based Millennium environment, EMC VMAX enterprise storage provides tight integration with VMware to simplify virtualization while maximizing performance and efficiency. In fact, EMC’s tests of virtualizing Oracle resulted in a 300 percent increase in OLTP performance, 82 percent savings in space and power, and 30

percent savings in administration staff. VMAX also provides Data at Rest Encryption (D@RE), a critical element for securing data at the drive level to meet HIPAA and meaningful use requirements.

In addition, VMAX is "cloud-ready" for providers expanding as regional healthcare providers. The linear scalability of VMAX offers high levels of performance and agility needed for cloud implementations, enabling users and workloads to grow and shrink without compromising performance or imposing additional costs.

In some cases, performance issues in highly virtualized Cerner environments can emerge due to excess latency from virtual desktops. Running virtual desktops on Vblock Specialized Systems for Extreme Applications with EMC XtremIO solves these problems. XtremIO, a flash-based array, delivers performance and low-latency that are ideal for virtual desktops.

XtremIO also greatly accelerates the task of creating space-efficient clones or copies of the database for hospital operational reports, such as re-admittance rates or nutrition statistics, and eliminates the financial impact of traditional cloning methods. With XtremIO, copies of reports from Cerner’s Oracle database can be created as snapshots, which only capture updates or changes with pointers back to the source database. Snapshots require significantly less storage capacity than clones and can be created in nearly limitless quantities. The result is substantial financial savings for Cerner customers.

**Design Recommendations**

When planning a storage infrastructure for Cerner Millennium, special attention is needed for configuring the storage to deliver the performance and availability required by the specific Oracle database design within each Cerner customer’s environment. This will vary based on workload. Any requirements for virtual desktops also should be taken into consideration.

In addition, EMC recommends the following best practices:

- When designing Oracle databases, take into account the redo logs, archive logs, and temporary database to ensure adequate performance. EMC XtremSF PCIe flash card can be an effective way to boost performance for Oracle temporary databases.
- Isolate the production database disk pool to maximize performance.
- Design storage with plenty of front-end processors to support overall I/O demand.
- If using ISL trunks, ensure adequate capacity and minimal latency to prevent network bottlenecks.
- Create file systems with a native block size two times the size of the database design to accommodate Oracle’s unique read/write pattern.

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AVAILABILITY AND DATA MOBILITY

Top availability of the Cerner EMR is critical since even momentary disruptions to clinicians accessing patient charts, diagnostics, or lab results could seriously affect quality and timeliness of patient care. At a minimum, storage for Cerner Millennium must offer high levels of system redundancy. In addition, Cerner applications demand protection against site outages and downtime even for regularly scheduled maintenance. This means eliminating single points of failure and potential for data loss.

Active-Active Configurations for Oracle Databases

Because Millennium is based on Oracle, Cerner customers can address these challenges with Oracle Real Application Clusters (RAC), which enable a single Oracle database to run across multiple servers while accessing shared storage. To overcome Oracle RAC’s limitations with supporting servers located in geographically separate data centers, EMC recommends implementing EMC VPLEX with Oracle RAC to create a true active-active data center configuration (Figure 3).

With VPLEX, data is continuously synchronized across both data centers so Oracle database services and Millennium applications run uninterrupted if site outages occur. In this way, healthcare providers achieve disaster avoidance, not just disaster recovery, enabling a recovery point objective (RPO) and recovery time objective (RTO) of zero. And clinicians are assured of absolute availability of vital medical information at all times.

VPLEX also addresses the challenge that many Cerner customers face when migrating large volumes of data from one system to another. While traditionally large data migrations can take months or even years to complete, VPLEX moves applications and data in real time with no outage required.

Automated Data Path Management

Another important consideration is EMC PowerPath, which enhances availability, as well as performance, of Cerner Millennium. PowerPath automates data path management and optimizes load balancing far more effectively than native operating system multipathing solutions. Its automated failover and recovery eliminate potential disruptions due to path failures.

In addition, PowerPath continuously monitors each path to ensure viability for its assigned workload, eliminating bottlenecks.
**Tiered Storage Availability Options**

For Cerner environments that demand six-nines availability, EMC recommends VMAX for the storage infrastructure. VMAX offers optimized hardware logic and data protection encoding to ensure end-to-end data integrity and automated channel failover.

For virtualized Cerner environments where five-nines availability is sufficient, EMC recommends VNX for the storage infrastructure. VNX is optimized for virtual applications, ensuring application availability and data protection with any-point-in-time recovery built in.

For providers wishing to accelerate their deployments and streamline day-to-day management, Vblock converged infrastructures with both VMAX and VNX storage options also are available.
VIRTUALIZED DESKTOPS

Use of virtual desktops in Cerner EMR environments is growing to support greater mobility for clinicians. By virtualizing desktops, clinicians can access and share medical information regardless of device or physical location, greatly enhancing efficiency and responsiveness of patient care. Virtualizing desktops also enables IT to reduce deployment and support of physical assets, saving time and money.

One of the biggest challenges in virtualizing desktops is ensuring adequate performance and scalability. EMC recommends an infrastructure using VMware Horizon View running on Vblock Specialized Systems for Extreme Applications configured with EMC XtremIO all-flash scale-out enterprise storage. Vblock Systems offer tight integration with the VMware operating system and Cerner Millennium to ensure rapid response times, high availability, strong security, and excellent agility. With XtremIO and Vblock Systems, Cerner customers can fully benefit from the extreme performance and scalability enabled by flash drives to support the largest virtual desktop deployments.

The Cerner Instant Access code is essential to the proper functioning of any Cerner virtual desktop implementation. EMC can work with providers to design and implement virtual desktop infrastructures for Cerner Millennium that incorporate necessary hardware and software.
BACKUP AND RECOVERY

Given the critical role of Cerner EMR in the patient care continuum, complete and reliable backups of Cerner environments are essential. Backups are typically a data source of last resort; that is, recoveries from backups are necessary usually when other data sources have been lost. Cerner customers should capture full backups as often as possible and be assured that restores with high data integrity are readily available.

The biggest challenge in backing up Cerner EMR is the Oracle database. Traditionally, Oracle database backups have involved third-party software and tape to create a backup. Due to limitations of this approach, including slow tape drives, unreliable tape media, insufficient LAN bandwidth, and overworked backup servers, large Oracle backups often exceed 24 hours. In addition, tape backups frequently fail, making recovery impossible.

High-Performance Direct Oracle Backups

As a best practice, EMC recommends backing up the Cerner EMR’s Oracle database directly to EMC Data Domain deduplication storage systems. Data Domain uses a highly effective deduplication method that reduces the amount of data sent to backup by as much as 30 times. The result is faster backups with less burden on the network. Deduplication also enables administrators to keep additional copies of data for longer periods, and because data is stored on disk, recovery from Data Domain is fast and reliable.

In addition, Data Domain integrates directly with Oracle Recovery Manager (RMAN), eliminating the need for third-party backup applications (Figure 4). Since many backup applications require expensive client and plug-in licensing software per database server, RMAN backing up Oracle directly to Data Domain can result in significant cost savings. This approach also frees up servers that can be used for non-Oracle backups across a healthcare enterprise.

![Figure 4 – Direct Backup of Cerner to Data Domain via Oracle RMAN](image)

 Providers can enhance backup efficiency further by using the Data Domain Boost plug-in for RMAN. Data Domain Boost distributes portions of the deduplication process from Data Domain to the Oracle database server, which can improve backup speed as much as 50 percent. Integration between Data Domain Boost and RMAN also can decrease Oracle CPU server utilization and reduce LAN bandwidth utilization by 80 to 99 percent because only unique data is sent to the Data Domain system. In addition, Data Domain provides Oracle database administrators with direct control over backup and recovery processes without involving the backup administrator.

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Replication and Archiving

To maximize protection of Cerner EMR data, EMC recommends that Data Domain be replicated to a remote Data Domain system using Data Domain Replicator, which is also controlled by RMAN. This approach provides Oracle database administrators with control over the replication process with full catalog awareness of all copies.

EMC also recommends regular disaster recovery testing using Data Domain fastcopy snapshot technology, which greatly simplifies testing and without disrupting backups or replication.

Since Data Domain systems can be shared for backing up Cerner and many other backup or archive applications simultaneously, EMC recommends that storage administrators set logical quotas based on the priority of each backup or archive job.
CONCLUSION

Cerner Millennium solutions are at the core of delivering quality, efficient patient care, touching nearly every aspect of clinical and administrative operations. Understanding the unique requirements of Oracle databases is essential to ensure performance, availability, and protection of the Cerner EMR. In addition, an infrastructure optimized for virtual desktops will enable greater mobility for physicians, nurses, technicians, and other clinicians.

EMC has a strong relationship with Cerner, and years of experience designing and implementing Oracle-based infrastructures to support the Millennium EMR. EMC offers broad knowledge and experience in healthcare, deep Oracle expertise, and a comprehensive portfolio of technologies ideally suited for Cerner Millennium environments.

By following EMC’s guidelines for Cerner Millennium, healthcare organizations can avoid many common pitfalls, accelerate rollout of their EMR, and maximize the return on their technology investments.