Hewlett Packard Enterprise

Reference Configuration

Hpe Reference Configuration for HPE Superdome Flex and HPE Primera Storage Running Epic Software

CONTENTS

EXECUTIVE SUMMARY

The HPE Superdome Flex sets a new standard for scalability and expandability while ensuring flexibility for all transaction, analytical, and data management workloads. HPE Superdome Flex coupled with HPE Primera storage is an ideal combination to meet the needs of any scale-up environment. This solution has the ability to start at 4-sockets/768 GB memory and scale-up to 32 CPU sockets/48 TB of shared memory, and also provides virtually unlimited storage capacity, thus meeting the need for the most demanding workloads. The expansive and configurable memory and processor options available within HPE Superdome Flex can speed up queries by orders of magnitude, while simultaneously processing transactions and serving the clinicians requests.

With our complete portfolio of servers, storage, networking, software and services, Hewlett Packard Enterprise is uniquely positioned to accelerate your hybrid cloud strategy through world-class software-defined IT solutions, proven hybrid cloud expertise, and a flexible consumption model that delivers a number of economic options and benefits. This can all be achieved while supporting your choice of on-prem solutions, cloud integration, workloads, and tools. Whether it is a departmental server, an enterprise data center, or anything in between, Hewlett Packard Enterprise has the breadth of innovation, open partnerships, and depth of expertise to bring it all together. Our AI driven data platform is implemented on-premises, built for the cloud, and delivered as a service. It predicts and prevents issues across your full IT stack with the ability to learn and self-adjust in real time, turning your data challenges into business opportunities.

This Reference Configuration demonstrates that the HPE Superdome Flex with HPE Primera storage is perfectly suited to handle any Epic® database workload. Using Epic on a caché operational database (ODB) with SMP architecture, Epic has validated 22M global references per second (grefs/sec) for 8-socket Superdome Flex solution on a configuration with Red Hat® on VMware®. For the Cogito Clarity® database running on MS SQL and physical Windows, Epic has validated the 8-socket solution performance up to 80 million grefs/sec. This Reference Configuration also showcases how HPE Superdome Flex provides superior Reliability, Availability, and Serviceability (RAS) for critical healthcare workloads. HPE Superdome Flex delivers mission-critical availability by incorporating unique and extreme RAS capabilities that keep your healthcare organization up and running. This document will explain in detail how the Superdome Flex servers fit this need and help the customers with the right solution for Epic implementations.

Target audience: This Reference Configuration is designed for health systems that require workloads with high performance and high reliability. Additionally, this document will aid CIOs with guidance for their organizations to determine when to implement an epic solution in their environments and the workload characteristics associated with those implementations.

Document purpose: The purpose of this document is to describe a Reference Configuration demonstrating the benefits of running Epic workload on an HPE Superdome Flex platform and HPE Primera storage.

This Reference Configuration describes solution testing completed in October 2019.

INTRODUCTION

As the Healthcare Industry grows and becomes more digitally connected, the IT teams that support healthcare organizations must find better ways to leverage technology to improve patient outcomes, workflow experiences for physicians and staff, and business operations with the goal to lower healthcare costs. The challenge is delivering this experience in a cost-effective way with the right mix of technology. Integrating new, future-ready technologies will help to ensure the right experience for each end user (patients, doctors, nursing staff, and so on.).

Epic measures platform scalability using a metric known as global references per second (grefs/sec), which represents the number of times per second that the database is referenced. Each health system will have a different mix of modules (i.e. Lab, ED, ADT, and so on) that require performance (grefs/sec) from the operational database (ODB). The hardware platforms rating is based on the number of grefs/sec that can be performed without degradation of response time. Many healthcare systems are approaching the 12M grefs/sec maximum on their 4-socket solutions. This growth has caused the need to test viable 8-socket solutions to support future scale-up and scale-out growth requirements for health systems. The support of 22M grefs/sec on the 8-socket HPE Superdome Flex Servers has been officially published by Epic. The 8-socket solution will also support physical MS SQL on Windows for the Clarity reporting workloads up to 80M grefs/sec equivalent.

Hewlett Packard Enterprise worked with Epic to test and validate the Superdome Flex solution's scalability limits, validating the hardware and the VM configuration settings for Epic workloads to run your mission-critical environment along with continually planning for the future. Hewlett Packard Enterprise offers the broadest portfolio meeting health system requirements including storage, servers, software, and networking.

For more information about Epic, see https://www.Epic.com/software.

InterSystems® has two major architectures: Symmetric Multiprocessing (SMP), which is a scale up architecture and Enterprise Cache Protocol (ECP), which is a scale out architecture. SMP is utilized in approximately 90% of the Epic customer base. This centralized DB architecture design allows for easy administration and also provides great scale up capabilities when coupled with HPE Superdome Flex hardware. On the other hand, ECP is a distributed architecture with separate DB and application servers. One of Epic's target platforms for the operational database is Red Hat Enterprise Linux® on X86 with VMWare vSphere®. This is where HPE Superdome Flex is the best fit when customer requires a solution to scale beyond 12M grefs/sec.

Unplanned outages in the healthcare industry have huge impacts to health systems and hospitals. Unplanned outages not only incur financial damages but can also impact human lives and the reputation of the hospital. Mission-critical solutions to run and ensure reliability are imperative. IDC characterized mission-critical solutions as follows: "Mission-critical workloads are solutions that propel a business forward. They support the business in every dimension — its organization, its employees, and its customers. They are the most demanding types of applications and databases running on servers today and include ERP, CRM, data warehouses, business intelligence, and analytics — and more. They must be available on a 24 x 7 x 365 basis given the encompassing scope of delivering healthcare and the reality that end users will be accessing those systems at any time, from any time zone". IDC also states the current trend is to move to the open architecture x86 platforms with mission-critical reliabilities. As customers transform their data centers, there has been increasing demand for "Unix on RISC"-like performance, RAS, scalability, and security on x86. This, in turn, has led to increased interest in x86-based scale-up systems with a larger number of sockets and cores to achieve a better cost-performance ratio.

For mission-critical workloads, HPE Superdome Flex provides the ease of scale-up combined with the capacity required to compute intensive workloads. HPE Superdome Flex can meet both performance demands and high availability features that customers require. HPE Superdome Flex can be easily scaled by simply adding additional chassis, there is no migration to a new server, simply add the new resources to the existing system. In order to provide high availability for mission-critical workloads, HPE Superdome Flex Servers offer RAS features in key hardware subsystems—processor, memory, and I/O—and provide the ideal foundation for mission-critical Linux®, Microsoft® Windows® and VMware operating environments. HPE Superdome Flex addresses the growing emphasis on availability and provides it through a layered approach that offers application, file system, and operating system protection through a comprehensive RAS strategy that covers all layers—from application to hardware. All components are fully redundant, ensuring the server will stay up and running throughout a problem or outage. In exceedingly rare cases, if a hardware issue occurs that would bring down other platforms, the HPE Superdome Flex's modular design is dynamic enough that the problem can be remedied by modifying the existing partition to exclude the problem hardware. The server can be brought up (with reduced resources), in order to continue operations.

SOLUTION OVERVIEW

The solution referenced in this document includes the HPE Superdome Flex with the HPE Primera all-flash storage, running the Epic EHR. The solution addresses the scalability and high availability requirements that are critical for healthcare systems.

HPE Superdome Flex

The mission critical HPE Superdome Flex platform is ideal for managing workloads that need to process the exponentially growing data of healthcare environments. HPE Superdome Flex is designed with a modular approach to adapt to ever increasing data management needs of healthcare systems.

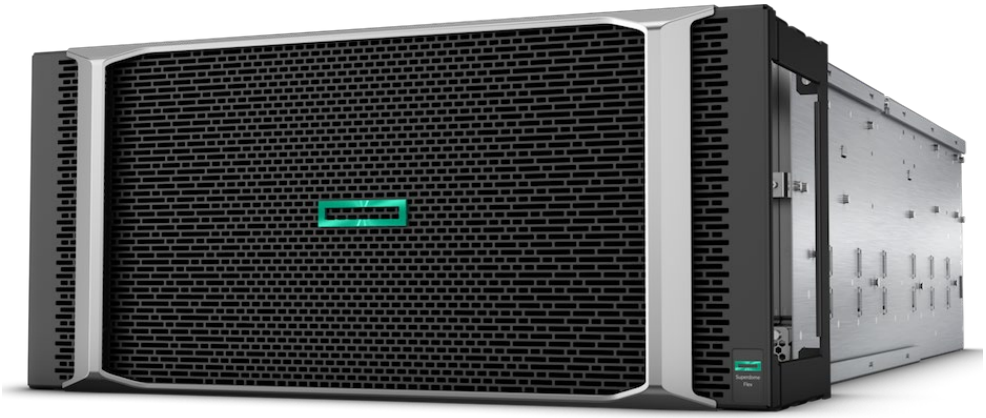

FIGURE 1. HPE Superdome Flex Chassis

With the HPE Superdome Flex Server, the server can grow along with your healthcare data needs. Start out as small as a single 4-socket chassis and grow up to 8 total chassis to a total of 32 sockets.

- 48 DIMM slots per chassis
- 16 I/O slots per chassis
- Support for 128 GB memory DIMMs and Intel® Xeon® Scalable processors, including Platinum, Gold, and M versions, including the ability to fully harness the potential of in-memory computing.

HPE Superdome Flex can be configured with an embedded management controller (for use with up to 2 chassis only) or an external rack mounted management controller (RMC).

The RMC is the administrative node for HPE Superdome Flex. The RMC includes one network port for administrative access to the system console. All administrative functions of HPE Superdome Flex are performed through the management controller:

- Configuring system partitions
- Network configuration
- Booting, rebooting, and shutting down the system
- Viewing hardware resources, and so on

Computing resources on HPE Superdome Flex are assigned using partitions. Partitions are currently aligned along the chassis boundaries within the HPE Superdome Flex environment. This greatly enhances the ease in which CPUs can be added and memory can be expanded to the installed operating system partition.

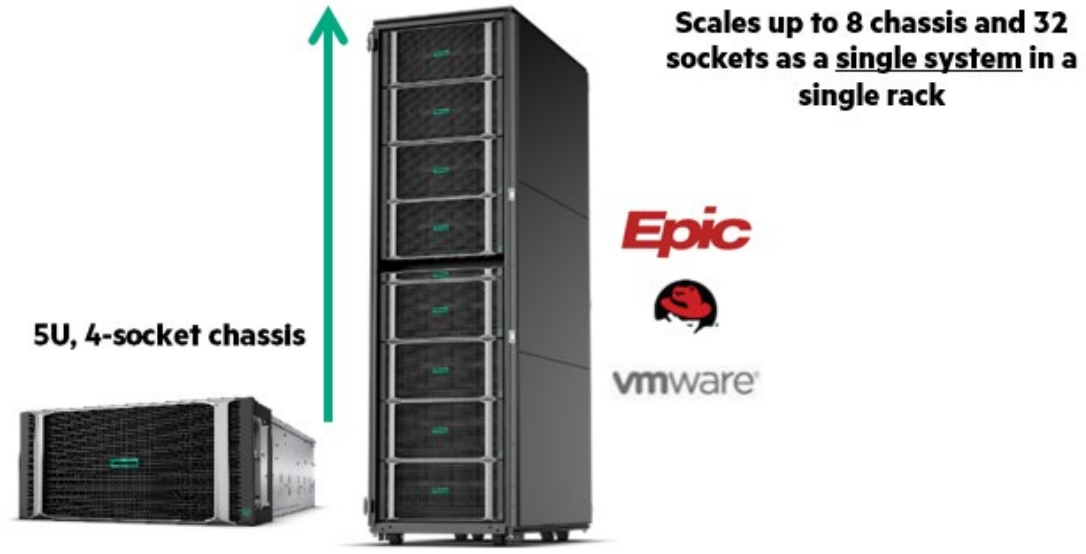

FIGURE 2. Scalability of HPE Superdome Flex platform

For your application workloads, the HPE Superdome Flex Server is a compute breakthrough, and it delivers an unmatched combination of flexibility, performance and reliability for critical environments of any size. It helps you outpace evolving data demands with optimum flexibility.

- A unique modular scale-up architecture utilizing a 4-socket building block lets you start small and grow at your own pace.
- It offers a cost-efficient entry point for mission-critical workloads at 4 sockets, and the ability to scale up at your own pace to 8 sockets.
- It is designed for environments of all sizes – never outgrow and avoid the need to over-provision. With up to 8 sockets/224 cores, you have plenty of headroom to grow.
- Its unbounded I/O allows it to support Epic EHR requirements easily.
- Flexibility in management with HPE OneView management and Redfish APIs.

It utilizes a modular architecture that scales seamlessly from 4- to 8-sockets in a single-system with Intel Xeon Scalable Processors both 1st and 2nd generation. Delivers 768 GB–48 TB shared memory for all size environments – from the smallest to the largest solution configurations.

HPE Superdome Flex delivers extreme and proven Superdome RAS features for highest service levels. HPE portfolio provides multiple High Availability and Disaster Recovery capabilities and HPE Pointnext services and expertise lower your risk for the best mission-critical experience.

The solution highlighted for this Reference Configuration features a two-chassis, eight processor partition. Additional chassis can be added at a later time by simply adding them to the existing partition.

HPE storage

HPE data storage solutions are fast, flexible, and efficient. The HPE storage portfolio covers the full spectrum of needs from small to very large enterprise environments. The HPE storage portfolio includes the new HPE Primera storage, built on years of past experience and incorporating leading-edge AI technology. HPE Primera storage performs wide striping of data across all back-end storage media for optimal performance. Wide striping of data means the storage system automatically provides optimal performance all the time—whether there is one volume or many volumes.

HPE Primera is a Tier-0 enterprise storage solution that delivers extreme resiliency and performance with the agility of the cloud. Built upon proven resiliency and powered by the intelligence of HPE InfoSight, HPE Primera storage delivers instant access to data with storage that can be customer installable, sets up in minutes, upgrades transparently, and is delivered as a service. HPE Primera provides always-fast and always-on storage for all mission-critical applications.

FIGURE 3. HPE Primera A650/A670 (4-Node Storage Base)

Figure 4 shows the user-friendly rear-view layout of the 4-node HPE Primera A650/A670 controller nodes. Note the optional six HBA slots per node pair. This is a fully integrated 4U enclosure with NO external node-to-node cabling for reduced points of failure.

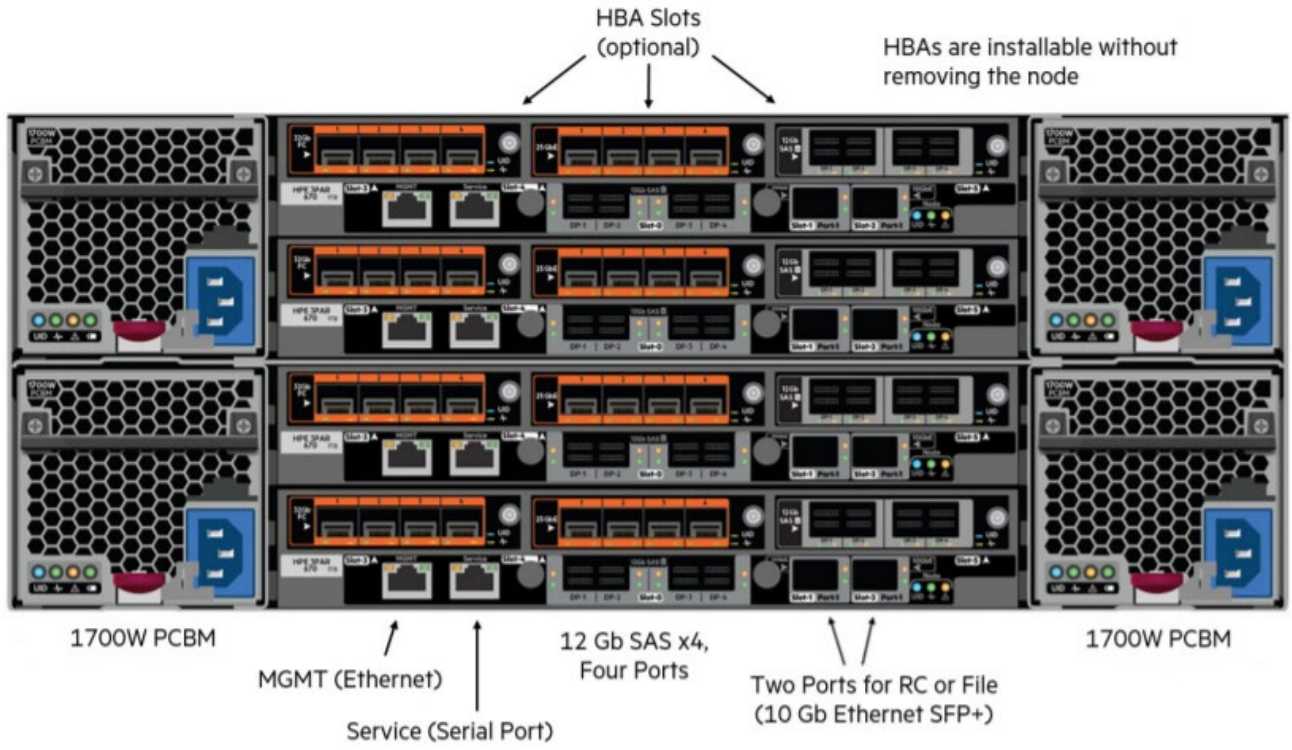

FIGURE 4. Rear-view layout of the 4-node HPE Primera A650/A670 controller nodes

HPE Primera 600 Storage value propositions include:

- HPE InfoSight embedded AI storage
- Functional design with simplified cabling, node orientation, hot-swappable interconnect cards, and the HPE Primera management interface for basic management tasks
- HPE Recovery Manager Central (RMC), customized scripted integration for app-aware data protection
- HPE Primera ASIC optimized performance with new active-active design
- HPE OneView support starting with version 5.10

HPE InfoSight

HPE InfoSight helps predict and prevent issues that can cause performance issues or downtime. HPE InfoSight incorporates AI-driven, machine-learning advanced analytics that simplify how your infrastructure is managed and supported. HPE InfoSight is an increasingly important technology built into HPE Primera storage, providing value differentiation by reducing management and tuning time. Traditional monitoring and support are far too removed from infrastructure, resulting in an endless cycle of break-fix-tune-repeat. Infrastructure powered by the artificial intelligence of HPE InfoSight can overcome the limitations of humans and traditional tools.

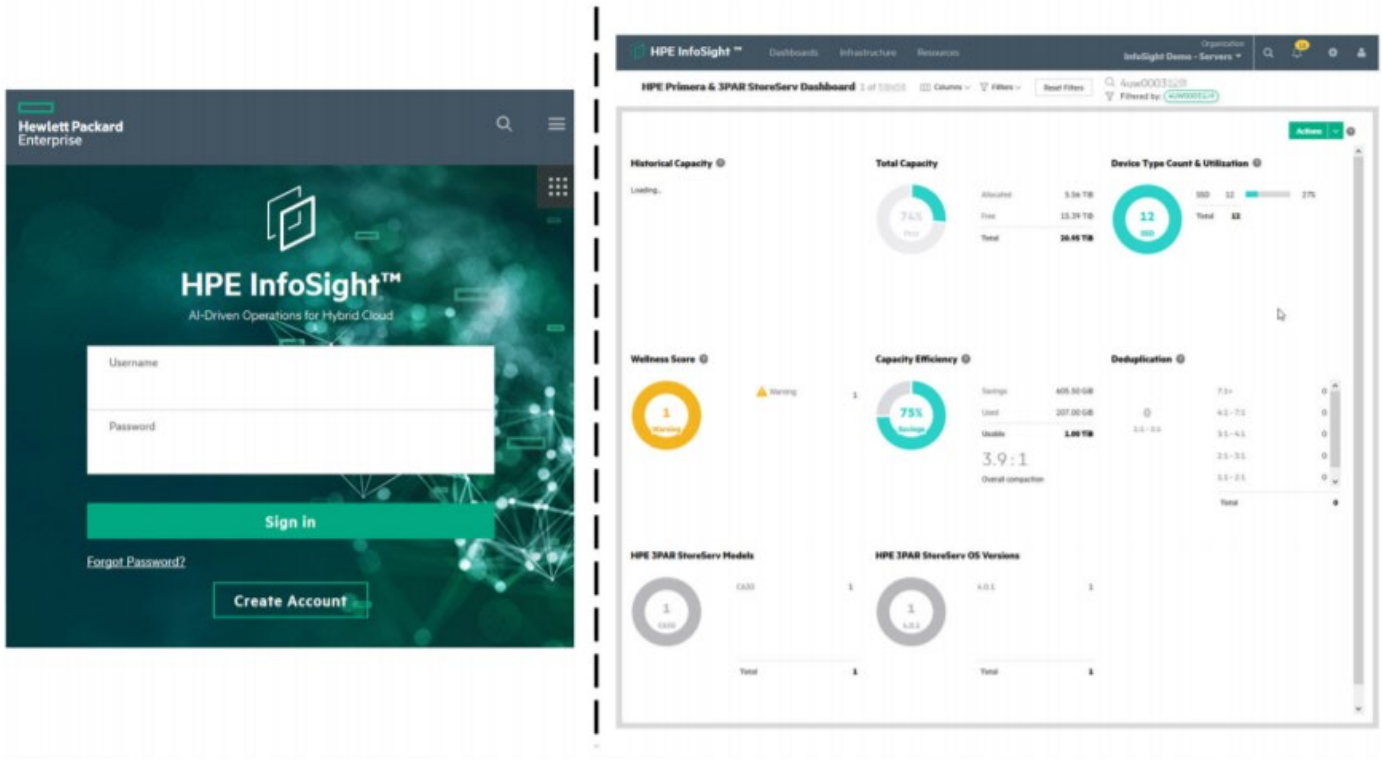

FIGURE 5. HPE InfoSight example user interface

HPE RMC integration

HPE RMC is integrated into HPE Primera storage for data protection that extends to the cloud. RMC provides the functionality for direct backup from HPE Primera storage to HPE StoreOnce that is over 20x faster backup than traditional backup solutions. RMC gives easy public cloud protection with HPE CloudBank storage. At the heart of every HPE Primera system is the HPE Primera ASIC, which is designed and engineered for NVMe performance. There are up to four ASICs per node, and each ASIC is a high-performance engine that moves data through dedicated

PCIe Gen3 high-speed links to the other controller nodes over the full-mesh interconnect. An HPE Primera 600 Storage system with four nodes has 16 ASICs totaling 250 GiB/s of peak interconnect bandwidth. These interconnects each have 64 hardware queues with priority control to meet the low-latency and high-concurrency demands of an NVMe-centric architecture.

HPE SOLUTION DETAILS RUNNING EPIC SOFTWARE OR EPIC EHR

The Epic application has multiple components including the ODB, Reporting, Web and Service, and Presentation components. The HPE Superdome Flex Server has been validated for use for the ODB and Reporting components. This provides customers the strategic choice of being able to scale x86 solutions, starting from 4-sockets to up to 8-sockets. No other x86 solution can deliver an x86 server solution that can scale and has the RAS features that HPE Superdome Flex provides. For customers who are currently operating at the 9-10M grefs/sec range and could very well grow over 12M grefs/sec during their next server lifecycle, they should consider the HPE Superdome Flex solution.

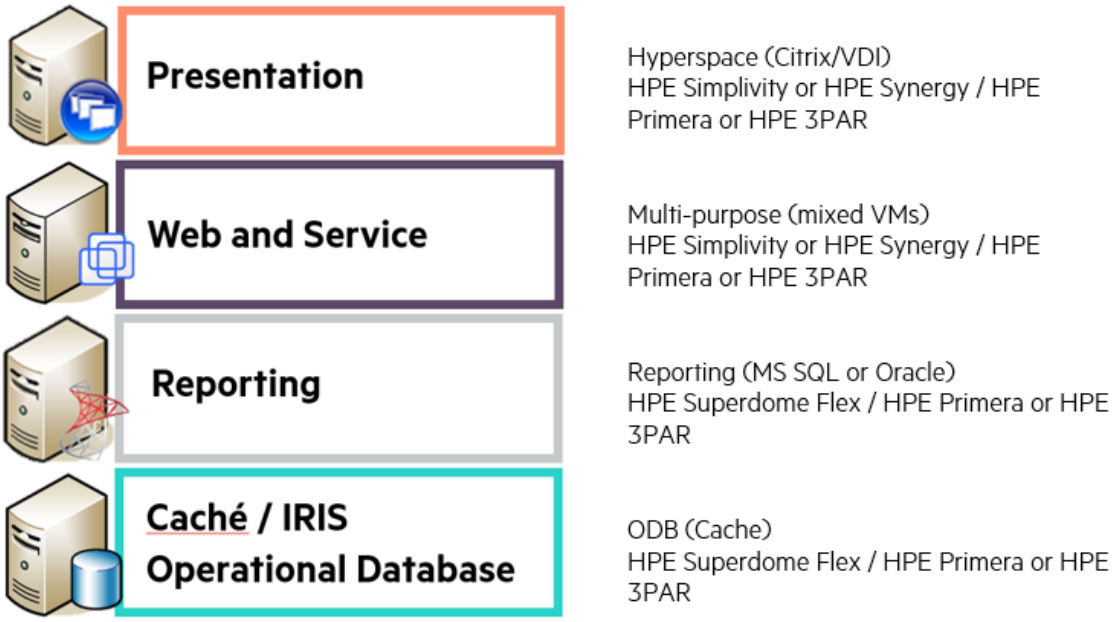

FIGURE 6. Example mapping of HPE platforms for Epic software layers

For the ODB, one possible solution is InterSystems Caché®/ InterSystems IRIS™, on RHEL, on VMware ESXi™, on x86 architecture as mentioned prior. Currently, the HPE Superdome Flex Server is validated for 8-sockets for the SMP architecture. Epic continues to test 8 and 16-socket solutions for SMP and 8-socket solutions for ECP architectures. For the Reporting servers, one target platform is Windows SQL on Windows Server, on VMware ESXi, on x86 architecture. The HPE Superdome Flex Server has also been specifically validated to support this Epic component.

Hewlett Packard Enterprise is working directly with InterSystems to also test future versions of the IRIS ODB. This provides both InterSystems and Epic the ability to test and validate the scaling and security capabilities that the HPE Superdome Flex Server offers to healthcare organizations.

Hardware – Sample configuration

TABLE 1. Example configuration for typical Epic implementation

Requirements	ODB	Disaster Recovery	Cogito Reporting
Number of Hosts	3	1 Required 2 Total for HA of Disaster Recovery (Optional)	1
Hypervisor	VMware vSphere 6.7 Update 2		VMware vSphere 6.7 Update 2 (Optional)
Operating System	Red Hat Enterprise Linux version 7.5		Windows Server 2012 or higher
Network	Four 10 Gb network connections		Two 10 Gb network connections
Management	HPE Foundation Software 1.2.1-1		
Processor Quantity and Type	Eight-Socket 28 Core 2.5 GHz Intel Xeon 8180		
Minimum Memory (GB)	768		
Minimum Vendor Support	24 x 7 hardware support VMware Production Support		
Power	Redundant power supplies		
Storage access	Four 8 Gb or two 16/32 Gb Fibre Channel ports		
Backup	Backup device for OS backup & recovery		

Epic will provide your organization with a Hardware Configuration guide specific to your projected needs. Hewlett Packard Enterprise can work with you to translate that guide into specifications for HPE Superdome Flex.

HPE Superdome Flex High Availability

HPE Superdome Flex RAS

HPE Superdome Flex Servers offer RAS features in key hardware subsystems—processor, memory, and I/O—and provides the ideal foundation for mission-critical Linux, Microsoft Windows and VMware operating environments. The mission-critical HPE Superdome Flex addresses the growing emphasis on availability and provides it through a layered approach that offers application, file system, and operating system protection. The mission-critical HPE Superdome Flex infrastructure and the x86 operating environments provide a comprehensive RAS strategy that covers all layers—from application to hardware.

Fault management strategy

HPE Superdome Flex Servers fully realize HPE's design strategy for systems handling mission-critical workloads, which is to implement, when applicable, a four-stage RAS strategy of detection, logging, analyzing, and repair.

FIGURE 7. How RAS works on HPE Superdome Flex servers

This strategy keeps customer workloads up and their data available even in the presence of faults. In the rare event of an unrecoverable fault, the strategy still provides detection and containment to protect corrupt data from reaching the network and permanent storage.

When faults do occur that require support action, accurate diagnosis of the fault is critical to determine what is wrong and how to fix it right the first time. The following are some of the design keys for diagnostic abilities that are built in to every HPE Superdome Flex Server:

- Minimize time to repair
- Capture enough data to diagnose failures the first time
- Allow system to run after failure for complete error logging
- Ability to diagnose all system components (software, firmware, and hardware) via complete error logging
- Field-replaceable-unit (FRU)-level granularity for repair
- Component-level granularity for self-healing

Firmware First

Part of HPE Superdome Flex's comprehensive strategy for fault management includes Firmware First problem diagnosis. With Firmware First, firmware with detailed knowledge of HPE Superdome Flex system has the ability to quickly and accurately determine what's wrong and how to resolve it. Intel Xeon Scalable processors Enhanced Machine Check Architecture Gen2 (EMCA2) allows firmware a first look at error logs so that firmware can diagnose problems and take appropriate actions for the platform before OS and higher-level software involvement. Firmware First covers correctable errors, uncorrectable errors, and gives firmware the ability to collect error data and diagnose faults even when the system processors have limited functionality. Firmware First enables many platform specific actions for faults including predictive fault analysis for system memory, CPU, I/O, and interconnect.

RAS differentiators

While features such as hot-swap N+1 power supplies and single-/multi-bit memory error correction have become common in the industry, a number of RAS differentiators set HPE Superdome Flex Servers apart from other industry-standard servers. HPE Superdome Flex Servers offer several types of RAS differentiators:

- Self-healing capabilities
- Processor RAS
- Memory RAS
- Platform RAS
- Application RAS
- OS RAS

Self-healing

When faults do occur, HPE Superdome Flex provides several mechanisms to react so that unplanned downtime is avoided. Primary means of downtime avoidance include disabling failed or failing components during boot and attempting recovery on failed or failing components during run time. Taking failed or failing hardware offline allows the system to remain running with healthy hardware until the system can be serviced. Such self-healing capabilities avoid unplanned system downtime.

Deconfiguration of failed or failing components

HPE Superdome Flex provides the ability to deconfigure components so that any single hardware fault can be tolerated.

- Memory DIMM, I/O slot, and CPU core deconfiguration: Reactive and predictive fault analysis allows for deconfiguration of failed or failing memory DIMMs, I/O slots, and CPU cores so that the system can remain available with only healthy memory DIMMs and CPU cores in use.
- On a reboot, failed memory may be repaired using spare cells in the DRAM. This post package repair technology is supported on HPE Superdome Flex.

Faults in many areas of HPE Superdome Flex Servers result in run-time deactivation of resources to avoid continued usage of failing components. This level of self-healing provides zero system downtime and allows for repair actions at the next planned downtime event.

Processor RAS

HPE Superdome Flex Servers use the Intel Xeon Scalable processors. These processors include extensive capabilities for detecting, correcting, and reporting hard and soft errors. Since these RAS capabilities require firmware support from the platform, they are often not supported in other industry-standard servers.

Memory RAS

Main memory failures have been a significant cause of hardware downtime. HPE Superdome Flex Servers use several technologies for enhancing the reliability of memory such as proactive memory scrubbing and adaptive double device data correction (ADDDC). HPE Superdome Flex adds support for Post Package Repair to spare and replace defective portions of DRAMs. Additionally, HPE Memory DIMMs are qualified to provide both performance and quality. HPC applications may take advantage of the MEMlog memory RAS handling.

OS-level RAS

The mission-critical HPE Superdome Flex environment provides an unparalleled set of features to detect and recover from faults. Many years of collaboration between the processor, firmware, OS, and application design teams has led to the delivery of several advanced error-recovery capabilities.

BEST PRACTICES AND CONFIGURATION GUIDANCE FOR THE SOLUTION

The following section describes the best practices that can be used in configuration of Epic solution with HPE Primera storage as described in this document. Some of the parameters are based on the configuration we used in setup and testing and can vary from customer to customer. Please always consult Hewlett Packard Enterprise and Epic for any advanced solution configurations.

VM level setup

Operational database VM

Epic publishes a guide on their Galaxy documentation repository titled “ODB on Linux on VMware Architecture”. This guide contains detailed and updated best practices for host and guest configuration for running the Epic operational database on a VMware VM. This includes specific information necessary to successfully scale on an 8-socket server.

SUMMARY

Healthcare IT must find a way to move at the speed the business demands—agility is fundamental. The HPE Superdome Flex Server is a compute breakthrough that is designed to power critical healthcare applications, accelerate data analytics and tackle high performance compute and AI workloads holistically. It delivers an unmatched combination of flexibility, performance and reliability for critical environments of any size. A unique modular architecture and unparalleled scale allow you to start small and grow at your own pace. Leveraging its in-memory design and groundbreaking performance, your health system can process and analyze growing quantities of data at extreme speed. HPE Superdome Flex safeguards these vital workloads with superior RAS and end-to-end security. HPE Pointnext Services portfolio, broad partner ecosystem, and mission-critical expertise complement the capabilities and value of the platform to ensure your move to HPE Superdome Flex is a success in Epic EHR environments.

Implementing a proof-of-concept

As a matter of best practice for all deployments, Hewlett Packard Enterprise recommends implementing a proof-of-concept using a test environment that matches as closely as possible the planned production environment. In this way, appropriate performance and scalability characterizations can be obtained. For help with a proof-of-concept, contact an HPE Services representative (hpe.com/us/en/services/consulting.html) or your HPE partner.

RESOURCES AND ADDITIONAL LINKS

HPE Mission Critical Servers Reference Architectures, hpe.com/info/missioncritical-ra

HPE Reference Architectures, hpe.com/info/ra

HPE Superdome Flex Server OS Installation Guide, https://support.hpe.com/hpsc/doc/public/display?docId=a00038168en_us

Running Linux on HPE Superdome Flex Server, https://support.hpe.com/hpsc/doc/public/display?docId=a00058577en_us

HPE Primera Storage, hpe.com/Primera

HPE Primera Red Hat Enterprise Linux Implementation Guide, https://support.hpe.com/hpsc/doc/public/display?docId=c04448818

To help us improve our documents, please provide feedback at hpe.com/contact/feedback

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