



White Paper

Optimizing Scale-up, Mission-critical Enterprise Workloads on x86 Systems

HP Superdome X and Microsoft SQL Server 2014

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The State of Enterprise Data in a Big Data World

This is an exciting time in technology—an inflection point, if you will—where the exponential growth and disruption of megatrend technologies, such as big data, cloud, mobility and security, is forever changing the way business is conducted and the way IT must operate. The overwhelming speed and volume of information is driving a new era of compute platforms where innovative opportunities and faster time-to-revenue require unprecedented performance, scalability, and availability.

In order to keep up with these dynamic business demands, IT needs to be agile, efficient, and standardized. Infrastructures must cost-effectively scale up to meet the growth of business processing requirements without compromising performance, and maximize the value of their data through rapid, real-time analytics and business intelligence (BI). Now, more than ever, IT and business units must work together for their common good in a fiercely competitive landscape where the difference between success and failure could be measured in milliseconds.

HP has developed a powerful engine designed to fit this profile. HP Integrity Superdome X represents a new category of x86 modular, mission-critical systems that scale up at industry-standard efficiencies to consolidate all tiers of critical applications on a common platform. HP Superdome X delivers the performance as well as reliability, availability, and serviceability (RAS) required to optimize demanding, high-value, mission-critical workloads and large databases in scale-up x86 environments. It includes a modular, bladed design leveraging components common to other HP BladeSystem c-Class servers, as well as a common server management framework.

Building on its recently announced certification for use with Microsoft Windows Server 2012 R2, HP has also enabled HP Superdome X systems to run Microsoft SQL Server 2014 workloads for mission-critical applications. This combination of enhanced Microsoft SQL Server 2014 features with off-the-shelf HP Superdome X server capabilities has calmed the fears of many users who want to ensure that their business-critical, x86 applications are more reliable, faster, highly scalable, and fully optimized in production environments—expanding beyond the limits of standard x86 server offerings and in some cases displacing existing enterprise-class database systems.

Enterprise Database Trends

The evolution of cutting-edge technologies is creating new imperatives for IT. Critical business workloads are constantly changing and requiring rapid infrastructure adjustment to meet fluctuating demands. Even IT infrastructures for e-mail, and file and print have spiked variable, unpredictable workloads. Business happens everywhere around the clock, and IT needs to scale quickly to tailor customer-facing applications, whether they are on mobile devices, social media, or through connected devices. With decision-making occurring faster than ever, databases that house enterprises' most critical, secure information—from supply chain and core databases to order processing and payment systems—are exploding in size and need to be accessed with the highest urgency. The heat is on—enterprises still require the fundamental availability and security, but now need more scalability and speed with a lower TCO.

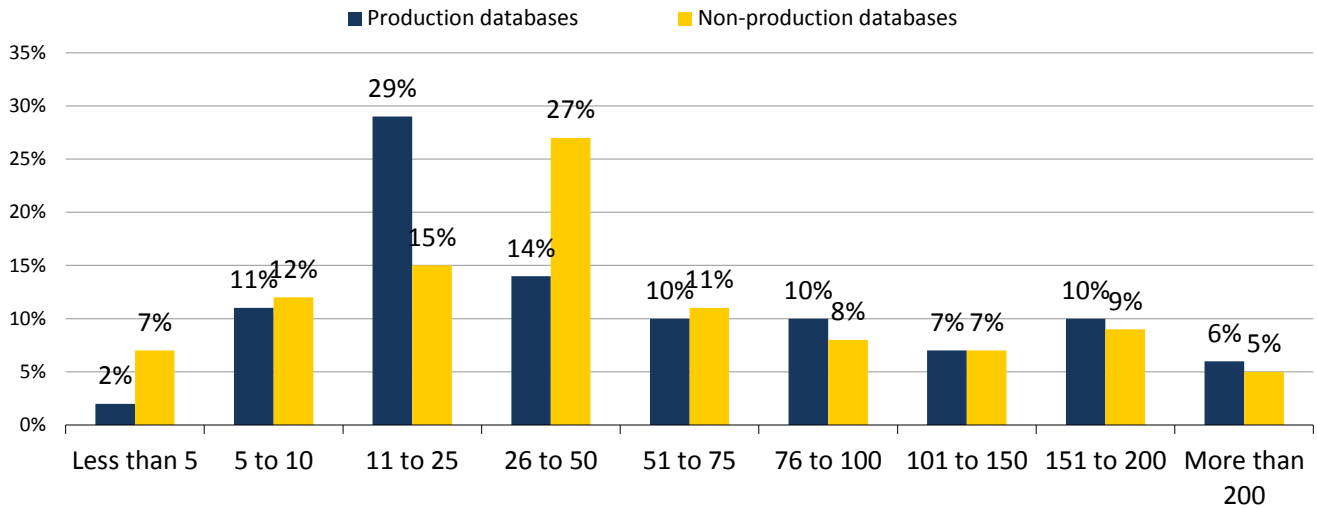
A recent research report from ESG delineates many big data challenges faced by organizations. Many are contending with database sprawl, causing them to pursue database consolidation efforts. In addition, the report finds that databases are also growing in size, which is the most commonly cited database challenge. Representing findings from 375 IT professionals across North America, this ESG study found that:

- At least 40% of organizations have more than 50 production and/or non-production databases (see Figure 1).
- Half of the respondent organizations are actively investing in a database consolidation strategy.
- More than one-quarter of respondents' databases are at capacities in excess of 10TB.
- Nearly one-third of respondents identify managing data growth and size as a database challenge, with almost 20% of the organizations citing it as their primary challenge.¹

¹ Source: ESG Research Report, [Enterprise Database Trends in a Big Data World](#), July 2014.

Figure 1. Total Number of Production and Non-production Databases

How many **production** databases does your organization currently have deployed? How many total **non-production** databases (e.g., development, test, parallel, etc.) does your organization currently have deployed? (Percent of respondents, N=373)



Source: Enterprise Strategy Group, 2015.

Existing x86 Challenges for Mission-critical Workloads

Clearly, a litany of lingering challenges still concerns IT at large enterprises. For example, the effects of even one hour of downtime can be far-reaching. With an average reported downtime typically measured in hours, this can quickly add up to incident costs that stretch out to tens, thousands, and hundreds of thousands of dollars for the most critical applications—in addition to the potential risk of lost revenue, brand destruction, or loss of productivity.

Table 1. Existing x86 Architecture Challenges

Challenges	Weaknesses of Existing x86 Architectures
Downtime is universally unacceptable in an always-on world	Extended planned and unplanned downtime requirements are needed for system maintenance. Uptime is not able to meet mission-critical SLAs
Mission-criticality of workloads is increasing	Require more reliability than existing x86 architectures offer
Scalability for large databases and new-generation workloads is becoming a top priority for flexibility	Limited scalability and availability
Big data and real-time data analysis are growing	Lack the performance to handle growing workloads
Security is a growing concern and top priority	Current information security can no longer prevent advanced targeted attacks
Aligning workloads with the infrastructure to support them	System inefficiency is a barrier preventing organizations from achieving their desired business outcomes
More integration of business and IT innovation	Require faster and more agile capabilities than existing x86 architectures offer
Simplifying IT management and reducing operational costs	Operational complexity and limited IT resources
Creating larger instances of databases in a single hardware box	Limitation to only create small instances of databases across multiple servers, which causes operational complexity as well as overall application design and architecture difficulties

Source: Enterprise Strategy Group, 2015.

HP Superdome X Solution

To counter these significant challenges of big data management, powerful servers geared toward scaling large production workloads and databases are needed, and to address the requirements for a reliable, robust infrastructure, platforms designed for high levels of availability are demanded. Enter HP Superdome X—the biggest, most powerful server in HP’s product portfolio.

Performance to Handle Massive Database Workloads

HP Superdome X runs the most demanding and largest databases—such as Microsoft SQL Server 2014—at industry-standard efficiencies in scale-up x86 environments without compromising high performance or availability. The HP Superdome X CPU is based on an advanced x86 architecture designed to support 240 cores and up to 12 TB of memory. In addition, four fully independent memory channels on each CPU socket all run in parallel. This gives each Superdome X blade the capability to support extreme memory capacity, low latency, and high bandwidth to power large, complex Microsoft SQL Server workloads.

However, even an extreme amount of CPU and memory performance is largely negated without extreme I/O capabilities to match. HP Superdome X’s high performance I/O provides up to 800 GB of aggregate bidirectional I/O bandwidth, bringing true performance balance to HP Superdome X, and addressing the largest in-memory database needs.

Just to put things in perspective, HP Superdome X delivers nine times greater performance and three times greater scalability than its fastest eight-socket predecessor, the HP DL980 G7.² These types of numbers cause users to consider consolidating workloads on a single server to reduce costs, and migrate from legacy infrastructures to speed IT delivery.

HP nPars Provide Flexibility and Cost Efficiency

HP hard partitions (nPars) is a high-value component of HP Superdome X x86 systems that was previously only available on HP’s more expensive, high-end alternatives and that adds significant value. HP nPars divides multiple individual physical blades into an independent unit by creating hard partitions across one or more blades. Though tied together through fault tolerant crossbars, the partitions can boot independently of each other, and each has its own CPU, memory, and I/O resources. Each nPar also runs its operating system and applications in isolation from the others. They are further supported with complete electrical isolation, providing a high degree of security between partitions and protection from hardware or software failures in other partitions.

One HP Superdome X server can handle several large instances of Microsoft SQL Server 2014, treating each one independently from the other. All this flexibility means users can create different development, test, pre-production, and production environments—encompassing the whole application lifecycle—in a single enclosure, all running different OSs and application versions. Enterprises can take a single nPar offline, and perform hardware or software maintenance and/or reconfiguration while the other nPars continue to run undisturbed.

These features lead to decreased TCO, maximized resource utilization, and improved uptime. nPars also streamline operations as IT staff no longer have to create and maintain multiple, small instances of Microsoft SQL Server 2014 across multiple physical servers. HP nPars represent a big step up from traditional x86 architectures, and a significant value proposition for HP Superdome X.

HP Superdome X Differentiators Improve Uptime

Firmware First—named for its ability to be first on the scene to identify and contain errors at the firmware level. It looks at error logs to diagnose problems before corrupted data reaches the OS and higher level software systems

² Source: HP internal benchmark results, August 2014, and external customer benchmarks, July 2014.

are impacted. One of the biggest concerns when errors occur is preventing data corruption, which this Firmware First approach can help with.

Error Analysis Engine (EAE)—correlates, analyzes, and automatically initiates self-repair for a hardware error. Embedding the EAE in the hardware and firmware eliminates the need for external diagnostic software. There is a level of self-repair done without human assistance, which is key to delivering the highest availability levels.

Crossbar Fabric—custom-designed to provide a high bandwidth path with low latency between all the processors within each nPar. It enables flexible scaling, allowing I/O to scale. Because of its fault tolerance, the fabric is able to survive a complete crossbar failure, reroute data, and recover immediately. Crossbar Fabric and memory RAS help avoid main memory failures, which are critical, especially for in-memory databases like Microsoft SQL Server 2014.

Operational Benefits Enable Flexibility for IT

The HP Superdome X is managed by the Onboard Administrator (OA), which is fed information by HP Integrated Lights-Out (iLO) management processors in each server blade. Companies can access the individual servers via iLO, or see the entire HP Superdome X system via the OA.

The OA makes life easier for IT and database administrators by providing a single point from which to perform basic management tasks for compute enclosures, server blades, and I/O interconnects. It also performs configuration steps that enable run-time management and configuration of complex components (the compute enclosure with all hardware components in it).

HP nPars and the EAE also help to alleviate IT management burdens. The EAE’s independence from diagnostic software and self-healing capabilities lighten IT’s load.

HP Superdome X Technical Specs

Table 2. HP Superdome X Technical Specs

Form Factor	2-Socket Blade	Enclosure
Compute Blades & CPUs	-2 CPU sockets for Xeon E7 v2 -Low and high core count CPU SKUs	-Up to eight 2-socket cell blades -2-16 sockets -Xeon CPUs in one or many nPars
Memory	-48 DIMM slots, 1.5 TB per blade with 32 GB DIMMs	-12 TB memory capacity with 32 GB DIMMs
I/O	-2 LOM cards: fully configurable / customizable 10Gbe Flex NICs -3 mezzanine slots	-16 LOM cards: Configurable 10Gbe Flex NICs -24 mezzanine slots
RASUM	-Mission-critical RAS -iLO 4 management processor	-Mission-critical RAS -SD2 based mission-critical OA
Partitioning & Virtualization	-Electrically isolate blades, can be grouped into nPars through the flexible crossbar fabric	-Electrically isolated nPars -Industry standard virtualization (VMware ,Hyper-V, KVM)

Source: Enterprise Strategy Group, 2015.

Microsoft SQL Server 2014 Solution

Mission-critical in-memory performance, faster insights from any data, and platform for hybrid cloud are the three pillars of Microsoft SQL Server 2014.

Speed for Transactional Processing

Mission-critical performance includes in-memory capabilities across all workloads, including online transaction processing (OLTP), data warehousing, and business analytics (BI). In-memory databases are faster because all the information is transacted in main memory, closer to the CPU and applications. Since data is easier to access, better performance and availability follow, especially when Microsoft SQL Server 2014 is deployed across the HP Superdome X architecture with memory fault tolerance designed specifically for this type of platform. Microsoft SQL Server 2014 also features an enhanced, in-memory ColumnStore that is updateable and provides significant data compression for faster queries.

At a recent Microsoft Ignite event in the U.S., Microsoft demonstrated how fast HP Superdome X queries can run against a 10TB database with 60 billion rows using ColumnStore indexes. A configuration using HP Superdome X 16S with Microsoft SQL Server 2014 processed 60 billion rows in 16 seconds.

Faster Insights from Any Data

In business intelligence environments, Microsoft SQL Server 2014 is benefitting users by providing them with more rapid insights into a range of data—big, small, and otherwise—while using familiar tools to deliver BI to business users in an optimized, consumable package. As a result, these users are able to combine this optimized data with the vast stores of unstructured data typically maintained by organizations of all sizes, and analyze it for use with mobile devices through tools such as Microsoft Excel, Microsoft Office 365, and PowerPivot, which enables in-memory analysis of billions of Excel rows per second for faster insights. Add in Microsoft SQL Server Analysis Services, which provide comprehensive, enterprise-scale analytics solutions, and the end result is a complete and consistent Microsoft SQL Server 2014-based BI platform running the gamut from on-premises to cloud-based processing.

Platform for Hybrid Cloud

Microsoft SQL Server 2014 offers an on-ramp to the cloud, which adds value by offering hybrid cloud capabilities such as backup, high availability, and other features designed to help organizations enhance on-premises business continuity while cutting costs. For example, with the platform for hybrid cloud, DBAs who are not experienced with Microsoft Windows Azure can still deploy and manage Microsoft SQL Server 2014 workloads to it.

HP Superdome X and Microsoft SQL Server 2014—Better Together

Target Workloads

Working together, HP Superdome X and Microsoft SQL Server 2014 are effectively targeting several workloads. Business processing workloads include such things as ERP, CRM, BI, and OLTP. These solutions are also purpose-built to provide high performance for decision support workloads including data warehousing/data marts, data mining, and business intelligence.

The performance capabilities of these combined solutions are purpose-built for large OLTP and data warehouse databases, mainframe and Unix re-platforming, and large-scale workload consolidation. With significant memory capacity, the solutions allow the support of large in-memory databases.

Flexibility Provides Significant Benefits

Together, HP Superdome X and Microsoft SQL Server 2014 have the efficiency to reduce complexity and cost. The unique x86 hard partitioning enables Microsoft SQL Server 2014 instances to be divided among as many or as few servers as needed. With the OA, partitions can be added, removed, updated, or reconfigured while the HP Superdome X is running without disturbing any OLTP or BI analytics being conducted on another partition. Not only does this lower TCO by streamlining IT operations, but it also reduces servers' footprints, reduces power and cooling, and decreases licensing costs.

TCO has been lowered through the use of a scale-up versus scale-out solution, which enables the consolidation of workloads like Microsoft SQL Server 2014 onto larger, more powerful servers. This promotes maximum resource utilization and easier data protection.

Availability Is Critical

Microsoft made its commitment to availability clear when it introduced its availability group feature for Microsoft SQL Server 2012, which provided the nines required by mission-critical workloads. It doubled down on that commitment with Microsoft SQL Server 2014 by increasing availability and efficiency, while making the capability easier to deploy and manage.

Microsoft SQL Server 2014 now enables enterprises to fail over multiple databases simultaneously both manually and automatically, and provides up to eight secondary replicas. This provides the ability to offload increased BI and reporting via additional secondaries for improved availability. It also supports Microsoft Windows Server 2012 R2 Clustered Shared Volume, enabling users to offer enterprise-class high availability without having to use SANs.

From an HP perspective, Superdome X provides reliability from the component level up to the solution level to ensure continuous services. Infrastructure reliability includes RAS features such as Firmware First, the nPars technology, and the EAE. Additionally, there is 100 percent application availability with HP Services such as Insight Remote Support and Microsoft Windows failover clustering.

Reduced Downtime

Some of the same RAS features that enhance availability also ensure reduced downtime. The occurrence of Microsoft SQL Server 2014 in-memory outages on HP Superdome X is reduced as a result of improved error handling found in the RAS capabilities that are driven by Intel Xeon E7 processors and HP nPars implementation. In addition, the Firmware First architecture contains errors before data can be corrupted, and the EAE ensures the system runs smoothly without outages. Combined, all of these factors enable HP Superdome X to keep running, thus avoiding data corruption leading to memory-related outages. This also means that memory density remains reliable for in-memory database functionality. This enhanced availability of the combined solutions increases competitive differentiation and reduces business risk.

Deploying Microsoft Windows SQL Server 2014 on HP Superdome X

In HP Superdome X and Microsoft SQL Server 2014 environments, users are able to run OLTP and BI workloads out of the same box, cohosting mixed workloads by taking advantage of nPars, running mixed workloads on a single partition, and dividing them into isolated partitions. The number of these partitions can be elastically scaled up or down to accommodate large-scale HP Superdome X processing demands, or shrunk to right-size the environment.

When migrating existing Microsoft SQL Server 2014 workloads onto HP Superdome X, it is simplest and quickest to preserve the legacy architecture where possible. Preserving the topology creates a one-to-one server to nPar ratio—one server equals one nPar. Though this is a quick and low risk migration strategy, there are several cons to consider, including suboptimal resource utilization, and the missed opportunity to consolidate workloads at migration.

The Bigger Truth

The right compute approach with the right mission-critical workloads has the power to transform business. It makes IT more services-oriented, lowers the cost of those IT services while reducing the time to deliver them, and increases their business value. Given the current data-driven business climate, this can happen none too soon.

It's clear that big databases are hot and getting hotter. It's not uncommon to find organizations that have 50 or more, and many of them are compromised by management challenges. Meanwhile, CIOs are wondering if their x86 systems are up to the task of handling them. Issues on their minds concern performance, reliability, availability, and serviceability.

HP has jumped into this market with its powerful Superdome X server, which features a number of impressive features that show its resiliency, and provide key architectural and operational differentiators. These advances go from the Intel Xeon processor, to the high performance blade architecture, to the system software, which features advanced partitioning and superior fault management. Microsoft also comes to the table with its own advancements, including high performance in-memory processing and faster data insights designed to accommodate mission-critical applications. HP and Microsoft are enhancing their relationship by deploying Microsoft SQL Server 2014 on HP Superdome X in an effort to capture a bigger share of the high-end, mission-critical business processing and decision support market. Given their longstanding partnership and the resulting solution that delivers on the enterprise's database needs, the two companies are well placed to grab a larger piece of the pie.



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