Transform your mission-critical environment

HP Integrity Superdome X

Leo Demers – Superdome X Product Manager

Tom Vaden – HP Server OS Architecture

June 25, 2015

Recent IT market trends and challenges

Datacenters under pressure to keep up with demands

Align with the business

Manage risk

Reduce cost

IT enters the irreversible x86 standardization journey

Control CAPEX

Add capacity incrementally

Deploy Linux commercially

Scaling out becomes standard, but at a cost

Dramatically increased OPEX

Hardware "sprawl"

Virtualization proliferation

IDC Analyze the Future

"Reducing costs has become increasingly critical… resulting in significantly less IT budget for delivering what's most important: innovation that can drive business growth in the 3rd Platform world."

The irreversible x86 standardization journey comes at a cost

Worldwide x86 Versus Non-x86 Server Shipments, 2008–2018

Legend:
— non-x86
— x86
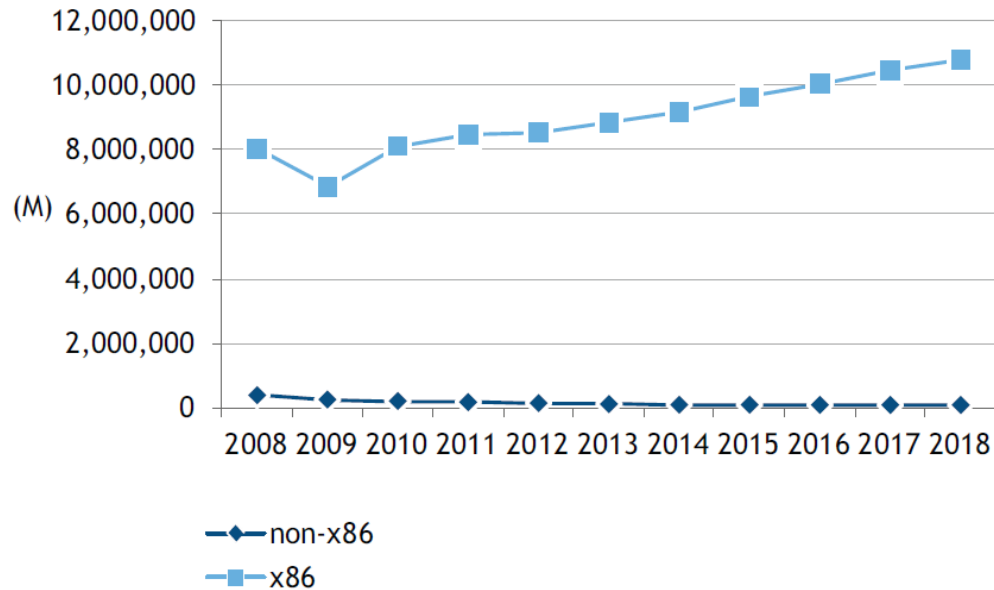
Worldwide New Server, Power and Cooling, and Management and Administration Spending

Legend:
- Power and cooling
- Server management and administration
- New server
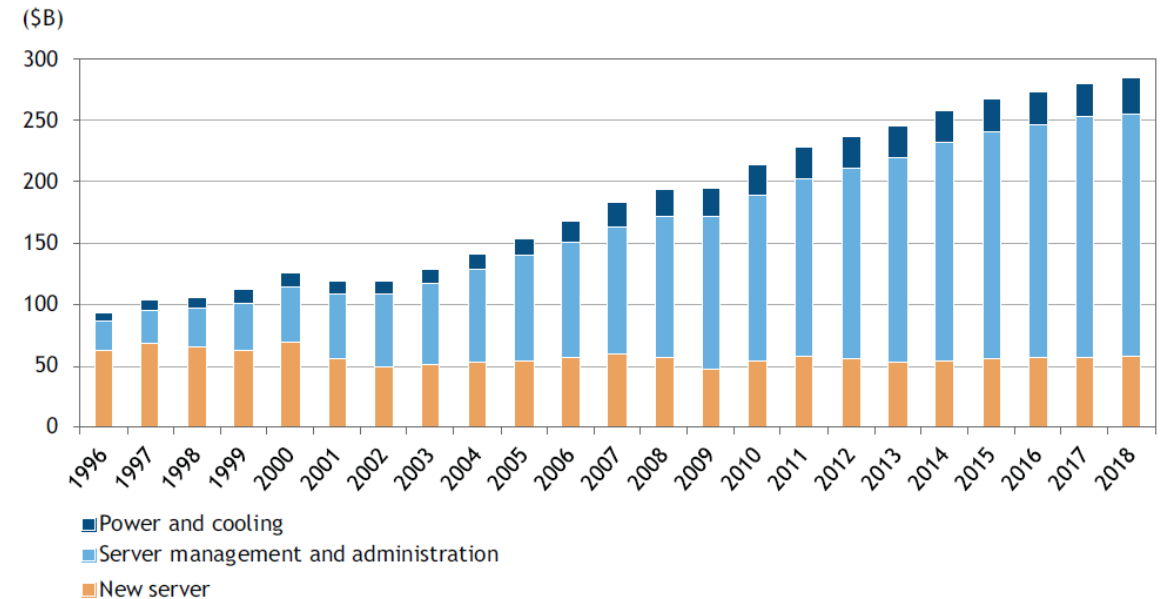
"But the shift to low-capex scale-out x86 systems also had **undesirable effects**. The increased opex of managing the expanding x86 installed base has been **taxing IT budgets**, making it **difficult to fund new initiatives** that might have delivered revenue-generating innovations."

IDC — Analyze the Future

HP Optimized Compute Portfolio

Drive Hybrid Infrastructure, Data Driven Organization and Workplace Productivity Transformations

Software Defined & Cloud ready

HP OneView

HP Helion

API

RESTful APIs

Workload Optimized
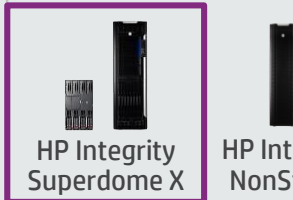
Core Business & Infrastructure applications	Mission Critical	Web scalability & SP optimized	Nex-gen Apps	HPC, Big Data
HP ProLiant Racks, Towers and BladeSystem	HP Integrity Superdome X HP Integrity NonStop X	HP Cloudline	HP Moonshot	HP Apollo Portfolio
Optimized for Virtualization; decreased TCO, productivity	**Availability** for continuous business	**Lowest cost** built to scale	**Optimized** for lowest TCO	**Density & efficiency** to scale rapidly
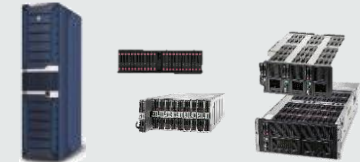
Converged

Converged network HP Networking	Converged management HP OneView	Cluster Management HP Insight CMU	Converged storage HP StoreVirtual VSA	Common modular architecture

Global support and services | Best-in-class partnerships | Converged System

Customer challenges on mission-critical computing

Business Processing and Decision Support workloads

"We're **deploying new applications on x86** and need more reliability than we have today."

"We need to **reduce our operational costs** for mission-critical applications."

"I'm not happy with the **downtime required** for system maintenance**.**"

"I need more scalability and availability for our **existing x86 applications.**"

"I'm **not getting the x86 performance** we require for our core database."

HP Integrity Superdome X

Drive business growth with groundbreaking mission-critical performance and availability at industry-standard efficiencies

Breakthrough performance for business transactions
9x performance than current HP 8-socket server

Increase competitive differentiation and reduce business risk
20x more reliability with **60%** less downtime than other x86 platforms

Redefine economics for mission-critical compute
32% lower TCO compared to competitive UNIX environments

New

Achieve breakthrough performance for business transactions

Increase agility and grow seamlessly with Superdome X

Achieve breakthrough performance, even when you scale to the largest configurations

9x performance
than current HP 8-socket server

Consolidate on a single server for lower cost

44x faster transaction process
than legacy high-end SPARC®/Solaris server

Migrate from legacy infrastructure to speed IT delivery

1.9x scalability factor

Scale confidently without compromising performance

Exceptional scalability and performance for OLTP database workload

Superdome X comparison to a DL980 G7

Superior performance with Superdome X

- **~ 2.4X performance** vs. DL980 G7 (8s to 8s)
- **1.6 scaling** from 2 – 4 – 8 sockets
- **Achieved ~ 90%** CPU utilization

Configuration

- RHEL 6.6
- OLTP database workload
- External storage for database
- SSD drives for log and data
- Separated storage partitions for log and data
- Balanced performance across NUMA nodes
- Up to 8 socket 120 cores with hyper thread enabled

Superdome X 2s, 4s, 8s and DL980 G7 OLTP Comparison

Legend:
- DL980 G7
- Superdome X 2s
- Superdome X 4s
- Superdome X 8s
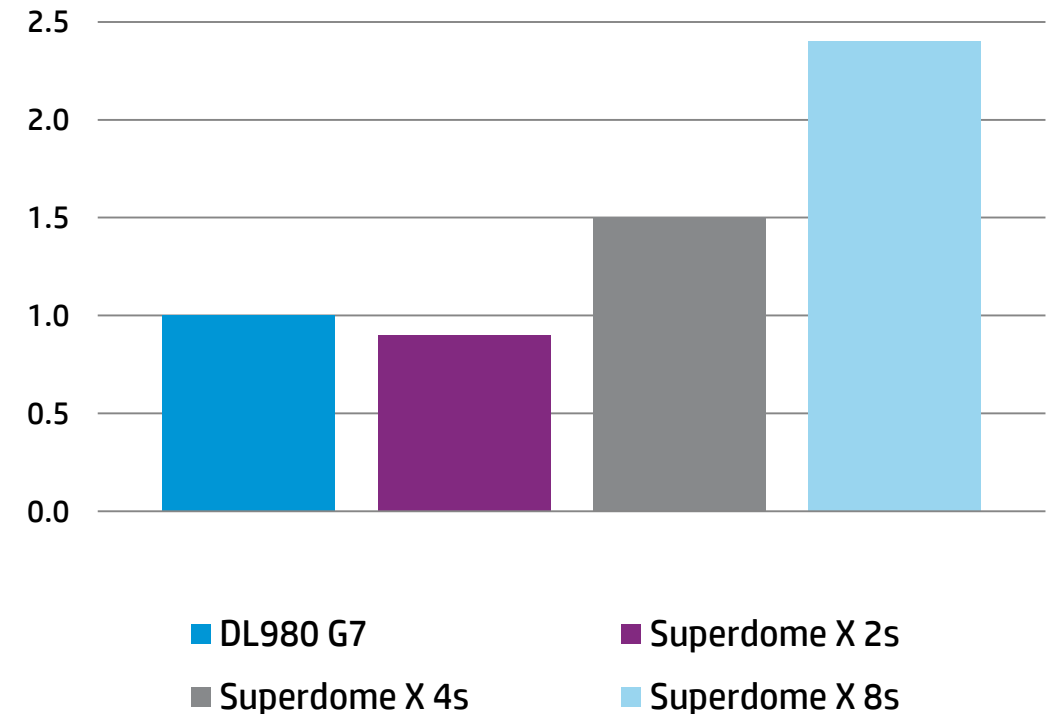
*Estimated workload based on known results of DL980 G7 with similar (OLTP) workloads

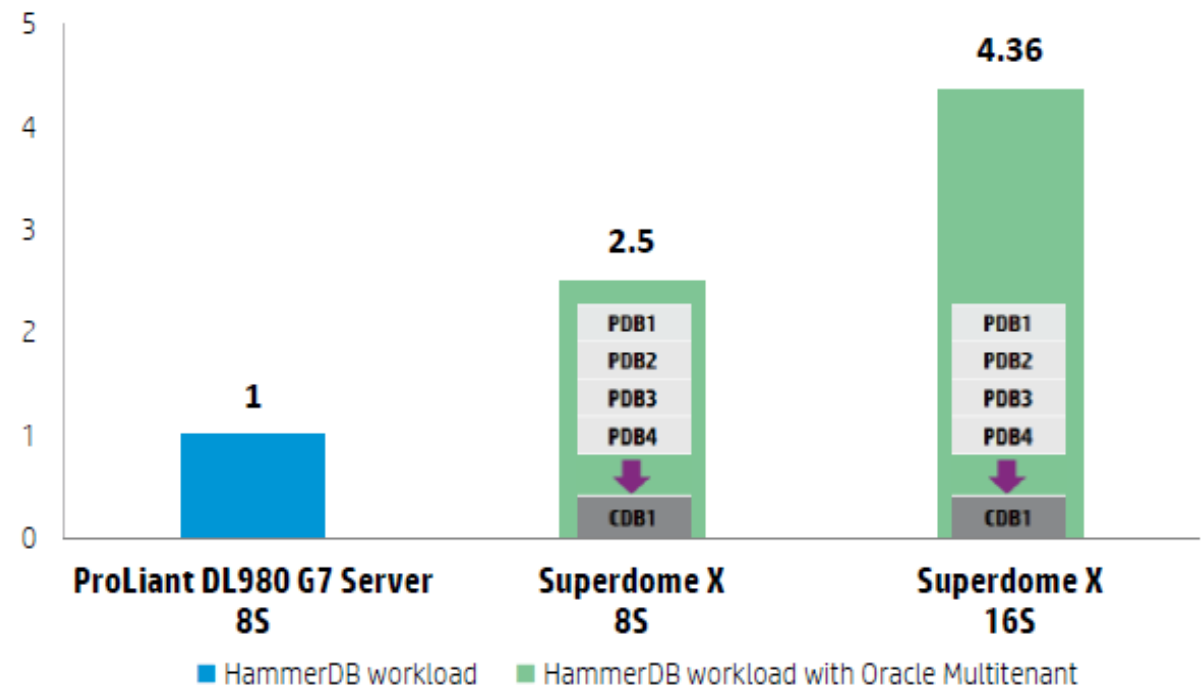# Consolidate in a large scale-up server without compromising performance

Superdome X demonstrates a 1.7x scalability factor using Oracle Multitenant feature

- Superdome X shows **1.7x scaling** from 8S to 16S
- **Balanced performance** across NUMA nodes
- **Lower TCO** by consolidating workloads

Configuration

- RHEL 6.6
- OLTP database workload
- Share external storage for databases
- SSD drives for log and data
- Oracle Multitenant, use 4 PDBs in 1 CDB

HP Integrity Superdome X Server 8S-16S consolidation scaling performance vs. 8S HP ProLiant DL980 G7 Server

ProLiant DL980 G7 Server 8S: 1
Superdome X 8S: 2.5 (PDB1, PDB2, PDB3, PDB4, CDB1)
Superdome X 16S: 4.36 (PDB1, PDB2, PDB3, PDB4, CDB1)

■ HammerDB workload ■ HammerDB workload with Oracle Multitenant

Statens Innkrevingssentral modernizes collections infrastructure

National Collection Agency selects Superdome X, 3PAR Storage and RHEL to lower costs and add performance

Profile

- Agency collecting fines, compensation, court case costs and confiscations, among others.
- **188** types of claims for **35** clients from **15** departments

Approach

- Migrate to x86 reliability and availability on the **Superdome X Server, 3PAR and RHEL**, including **RHEV** to drive down operational costs
- Focus on increased performance and improved availability

Results

- Streamlined online debt and fee collection for 35 government agencies
- Enabled 90% of collections to be processed online
- Delivers highly reliable infrastructure to support collection activities totaling up to ~2.5 M USD per day

10x performance boost

1/3 TCO vs. previous infrastructure

>30% deduplication of stored data

Mobile TeleSystems chooses Superdome X to power core database

- Powering core database for billing application

- Standardizing on x86

- Deploying in regional billing centers

- Requiring high performance solution due to company size and growth

- Migration project achieving

  - High ROI

 - More efficiencies

  - High performance and reliability

"The migration of core business critical applications to HP x86-based solutions helps us to reduce both CAPEX and OPEX for hardware platforms purchase and support. We got an opportunity to invest the freed up funds in development of new in-demand services"
— *Dmitry Khomchenko, CIO, MTS*

Increase competitive differentiation and reduce business risk

Experience superior x86 availability with Superdome X
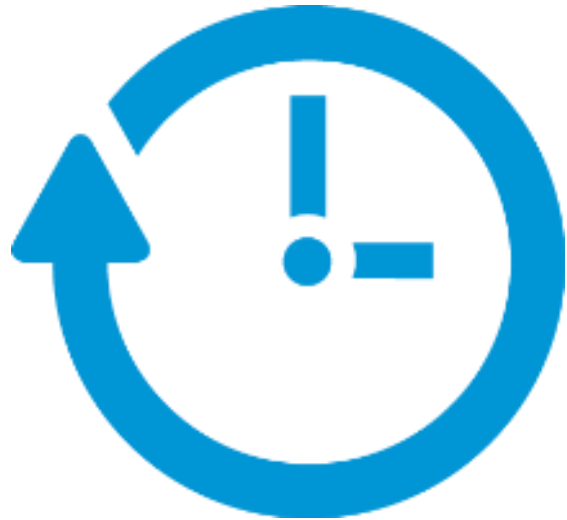
20x greater reliability with HP nPars

60% downtime reduction

Increase availability with **end-to-end** mission critical design
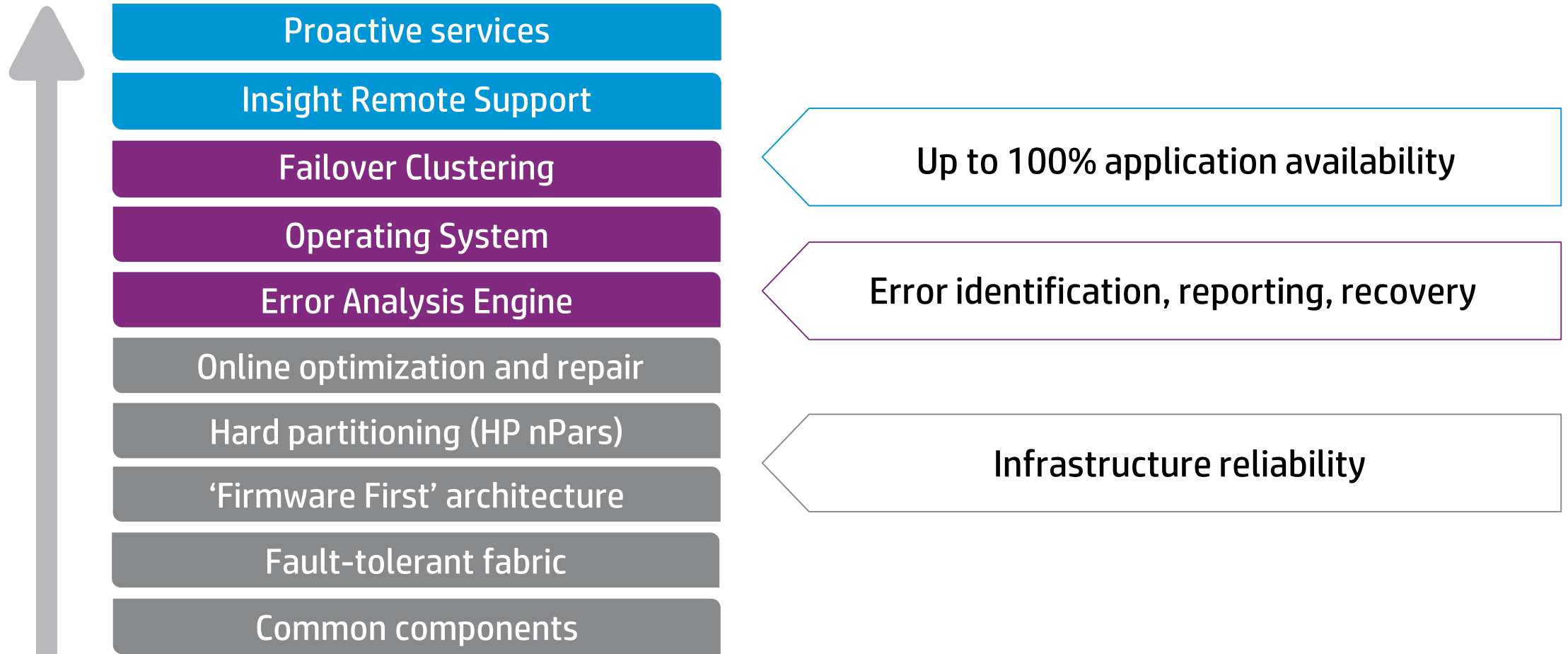
Zero planned downtime

Perform maintenance and updates **online** without application outage

95% reduction in memory outages

Ensure **continuity** with HP Firmware First

Availability from components to complete solutions

Superdome X with Power-on-Once technology

Proactive services	
Insight Remote Support	
Failover Clustering	Up to 100% application availability
Operating System	
Error Analysis Engine	Error identification, reporting, recovery
Online optimization and repair	
Hard partitioning (HP nPars)	Infrastructure reliability
'Firmware First' architecture	
Fault-tolerant fabric	
Common components	

End-to-end infrastructure reliability for the highest availability levels

Superdome X RAS features begin where most commodity x86 servers leave off

Superdome X

Reduce
human error

Error Analysis Engine predicts hardware faults and initiates self-repair **without operator assistance**
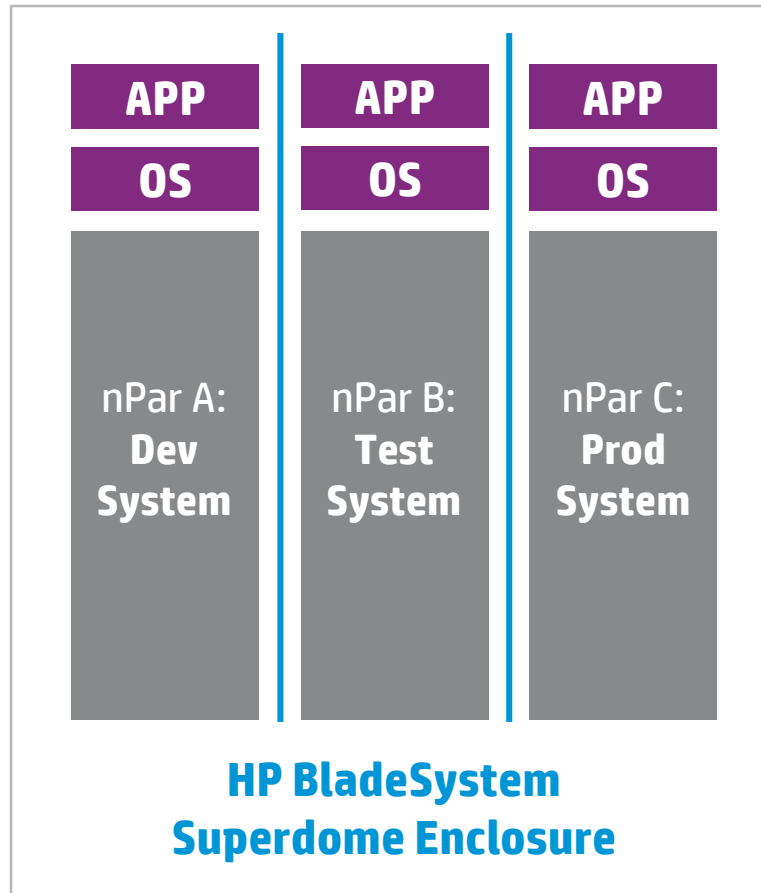
Prevent
data corruption

"Firmware First" ensures error containment at the firmware level, **before any data corruption** can occur

Minimize
time to repair

Quick and efficient service repairs—**often without tools**, many **redundant and hot swappable** components

The unique value of HP nPars

Hard partitions add flexibility and cost efficiencies

APP	APP	APP
OS	OS	OS
nPar A: **Dev System**	nPar B: **Test System**	nPar C: **Prod System**

HP BladeSystem Superdome Enclosure

Lower your TCO
Optimize software costs by using **HP nPars**

Maximize resource utilization
Create different **development, test, and production environments** within a single enclosure

Minimize downtime
Take one partition offline, perform hardware or software maintenance and/or reconfiguration, while the other nPars continue to **run undisturbed**
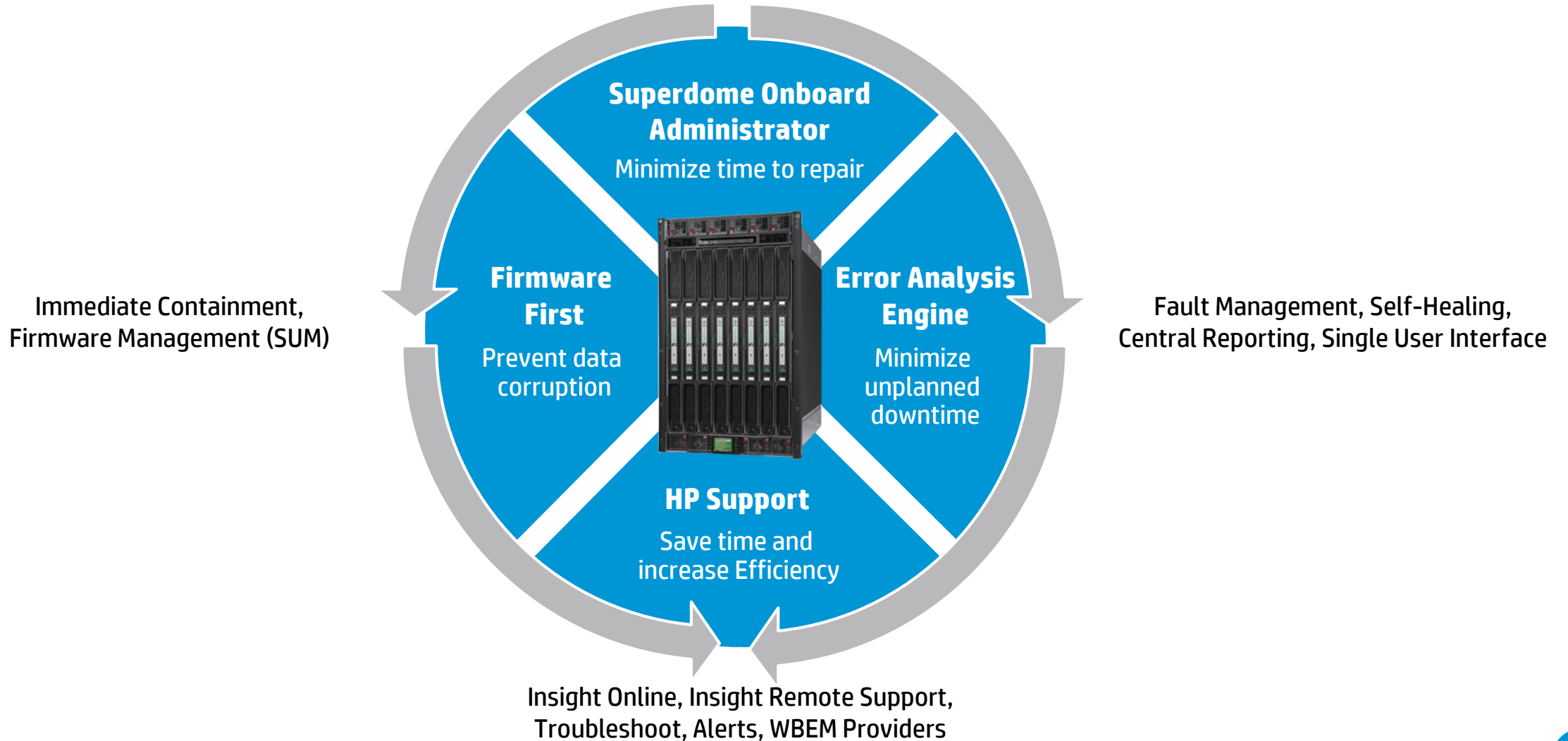
20x greater reliability than soft partitions

Protect your data
Electronic isolation provides a **high degree of security** between partitions

Intelligent management simplifies your environment

Redundant, Hot Swap, Fault Tolerant, Memory RAS

Superdome Onboard Administrator
Minimize time to repair

Firmware First
Prevent data corruption

Error Analysis Engine
Minimize unplanned downtime

HP Support
Save time and increase Efficiency

Immediate Containment,
Firmware Management (SUM)

Fault Management, Self-Healing,
Central Reporting, Single User Interface

Insight Online, Insight Remote Support,
Troubleshoot, Alerts, WBEM Providers

Linking directly into operating system software R&D

Unmatched partnership model maximizes mission critical capabilities

Driving innovations with partners and suppliers

Decades of mission-critical experience

Contributing what matters for mission-critical

Processor advancements

Hardware innovation

Data center ecosystem

RESEARCH & DEVELOPMENT

Upstream communities

HP & Red Hat - partnership

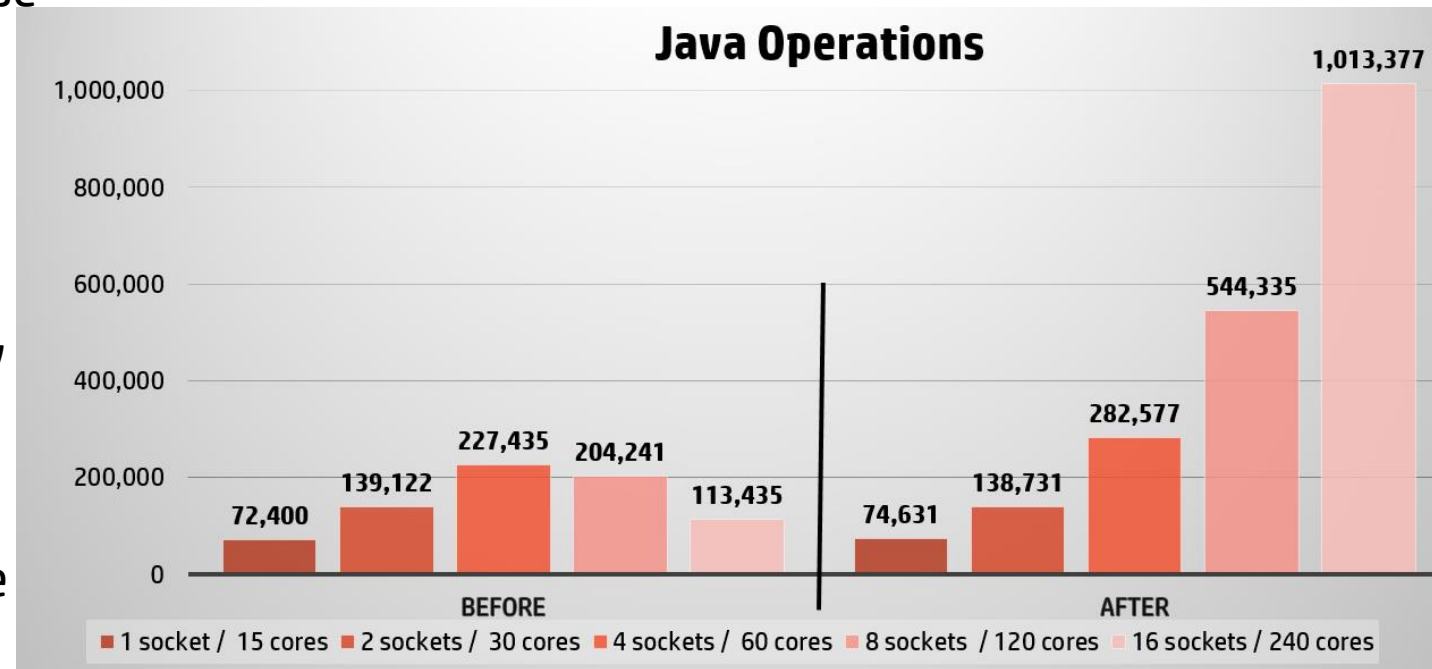# Linux kernel development to support Superdome X

Done in community partnership by Hewlett-Packard and Red Hat developers

- Identify areas to improve and problems to fix

- Determine if an upstream patch already fixes the problem.

- If no upstream patches exist:
  - Develop and validate fix
  - Submit the patches upstream and work the upstream process (an iterative process) until accepted

- Back-port patches to and validate on RHEL kernels

- Submit back-ported patches along with performance justification to Red Hat for inclusion in RHEL

- Changes put into the next RHEL release for all RHEL customers to use.

Superdome X performance improvements in RHEL

Made in community partnership by Hewlett-Packard and Red Hat developers

- Don't do an idle balance when it makes no sense

- Mutex optimizations in the construction and use of mutexes

- Mutex MCS optimizations

- Futex hash size, wait queue, and NUMA awareness optimizations

- Lockless atomic updates used by VFS directory entry reference counting

- SELinux bit-map optimization

- Parallel page fault processing for hugetlb page

- Better scaling of epoll_ctl() (heavily used by Java applications)

- Finer grained kernel locking in System V semaphores

Java Operations

	BEFORE	AFTER
1,013,377		16 sockets (240 cores)
544,335		8 sockets (120 cores)
282,577		4 sockets (60 cores)
227,435	4 sockets / 60 cores	
204,241	8 sockets / 120 cores	
139,122	2 sockets / 30 cores	
138,731		2 sockets / 30 cores
113,435	16 sockets / 240 cores	
74,631		1 socket / 15 cores
72,400	1 socket / 15 cores	

Legend: ■ 1 socket / 15 cores   ■ 2 sockets / 30 cores   ■ 4 sockets / 60 cores   ■ 8 sockets / 120 cores   ■ 16 sockets / 240 cores

Superdome X RAS innovations in RHEL

Made in community partnership by Hewlett-Packard and Red Hat developers
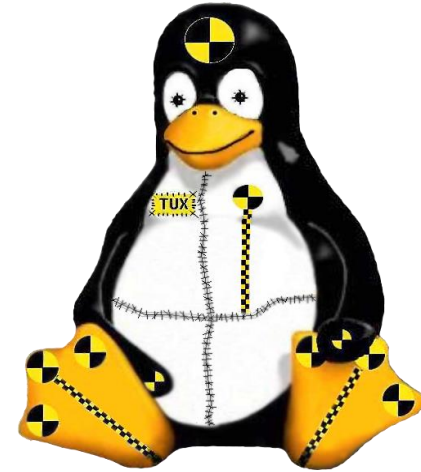
- Crashdump performance improvements
  - Vmcore access improvements
  - Compression in makedumpfile
  - Parallelism
  - Improving cyclic dump processing
  - Moving from a 6TB/240 core dump in *12 hours* to a 12TB/240 core dump in *16 minutes*
- Advanced error handling improvements
  - Kernel cooperation for Firmware First behavior
  - Enable advanced error analysis
  - Xeon EX advanced MCA recovery
  - PCI express LER support

- Virtualization enhancements
  - KVM scaling to 240VCPU/6TB guests
  - Migrate large-scale VMs while running with minimal application hesitation:
  - Enabling hot-plug for memory and CPU
  - Extend Advanced Error Reporting (AER) for VMs – isolate crashes only to affected VM
  - Improvements for NUMA Awareness to improve performance to near-bare-metal speed
 - SRIOV enhancements for device sharing and direct device assignments

HP Serviceguard

What causes the most business disruptions?

Single-system RAS is key but not sufficient for your most mission-critical workloads

- Human error
  - Lack of knowledge or training
  - Distractions / Carelessness
- Application failures
  - System patching (~2 months)
  - Performance / Capacity Planning
  - Application Architecture / Design
- Hardware, OS & Power failures
  - Fan / Memory / Disk failures
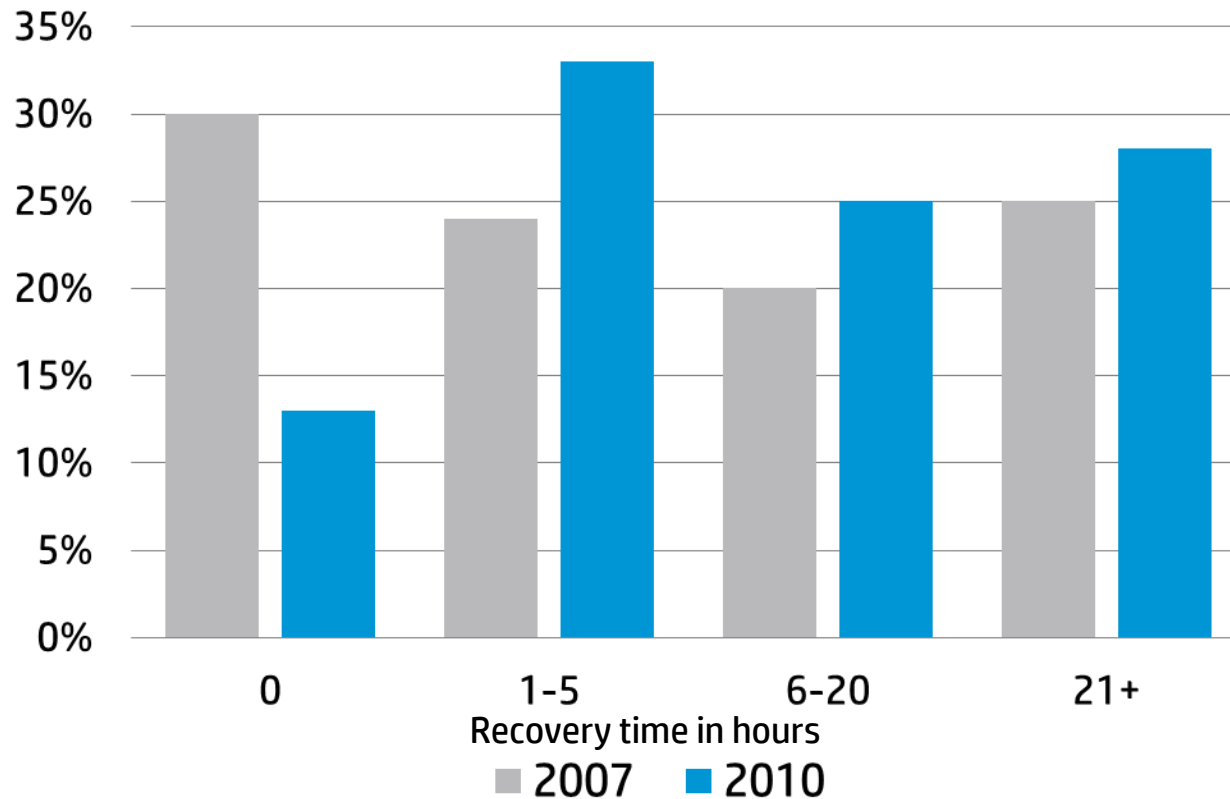 - OS crashing
  - Natural disasters

Hardware, OS & Power Failures — 20%

Human Error — 40%

Application Failures — 40%
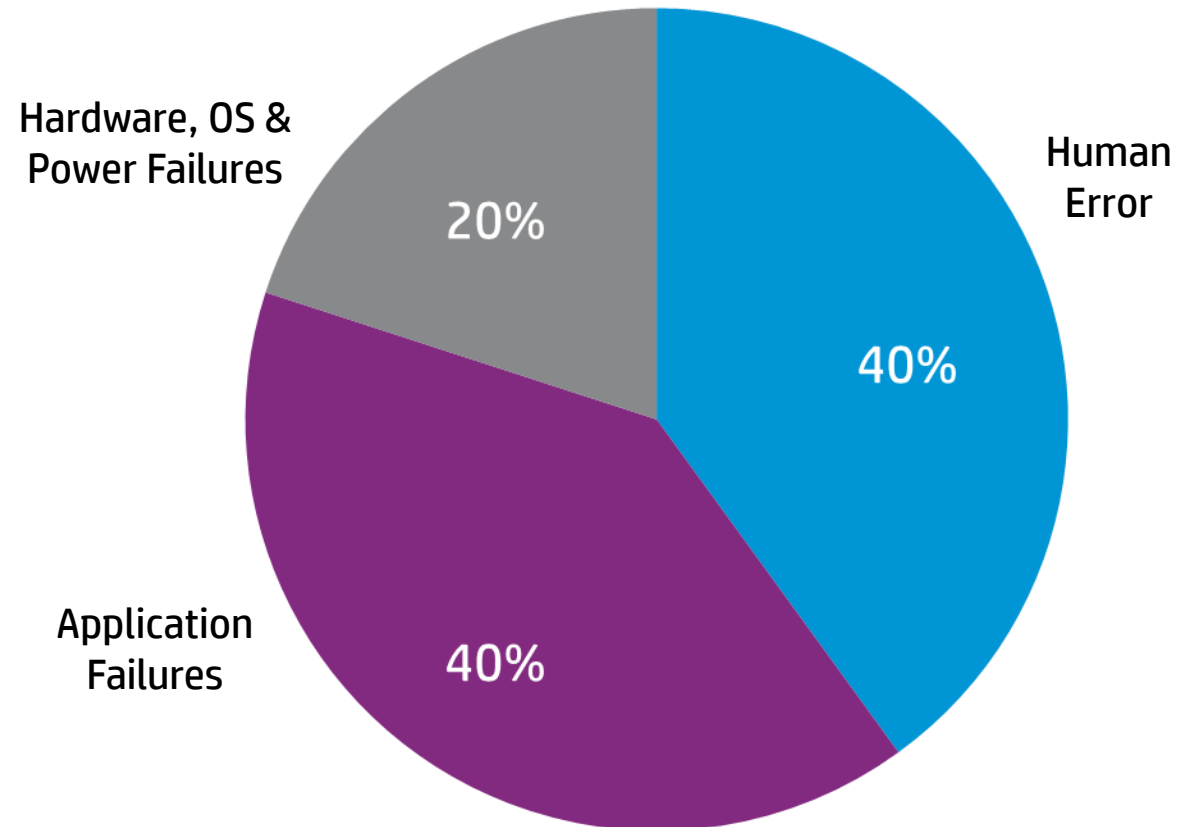
Causes of unplanned downtime

Source: Building an IT Disaster Recovery Modernization Business Case, Gartner Symposium 2011

Recovery times from business disruptions are increasing

Recovery time from major disruptions

- It took organizations 18.5 hours to recover from an event
  - Lost an average of 4.8 hours worth of data
- Almost 25% of companies are likely to declare a disaster within 5 years
  - 40% have had a major disruption to their business operations
- The average cost of a disaster is $1.4M
  - Average cost of downtime per hour is ~$145K

Source: Wake-Up Call: You Aren't Ready For A Disaster, Forrester 2011

Minimize application downtime with HP Serviceguard for Linux

4 sec failover time

Heal **transparently** and recover gracefully

Online operations over any distance

Protect **geographically dispersed** data centers

4x faster deployment

Simplify **set up and management**

What is HP Serviceguard

Application high availability clustering technology

HP Serviceguard

Servers

- HP Integrity
  - rx, BL, Superdome series
  - HP Integrity virtual machine

- HP ProLiant
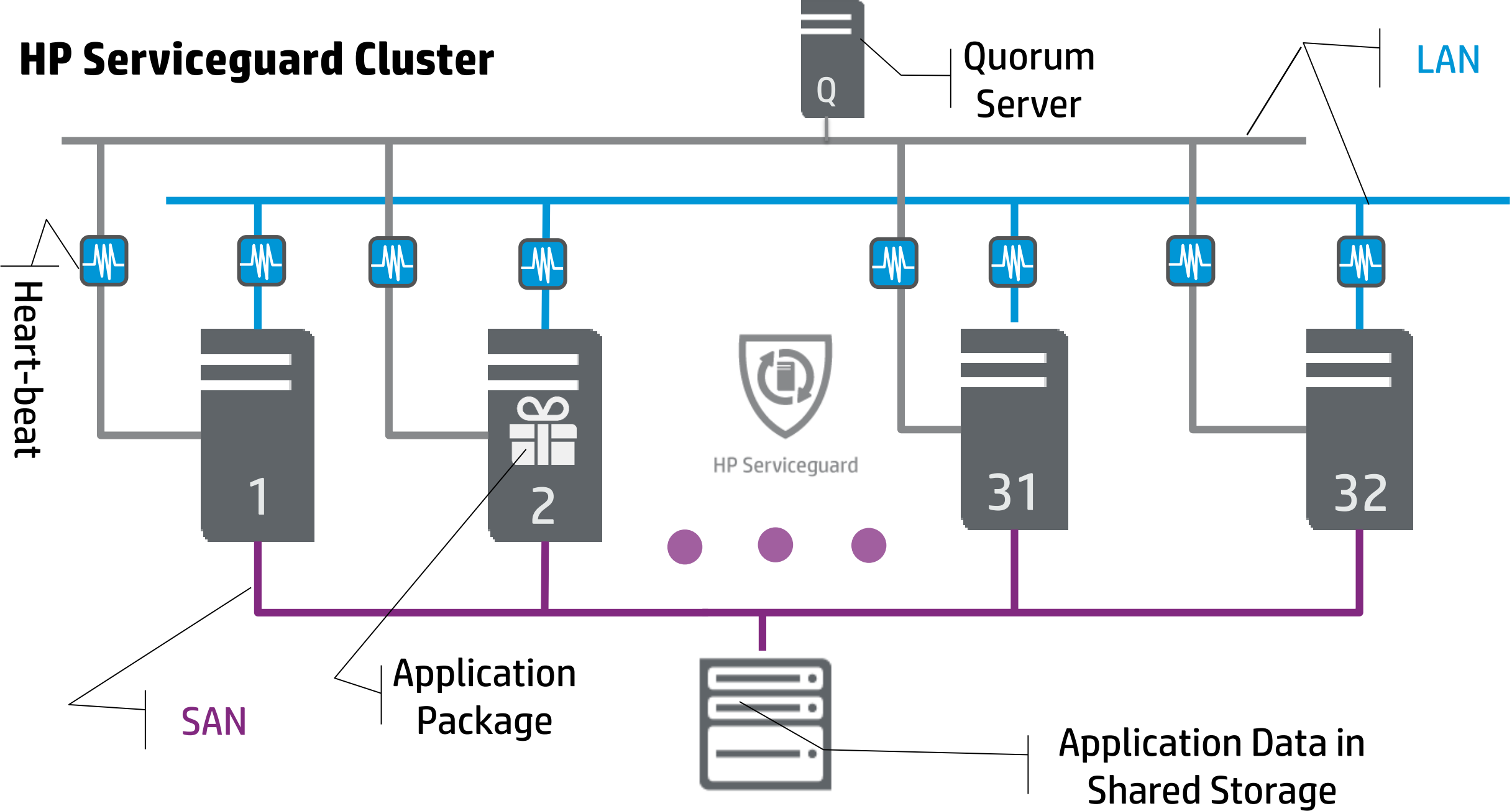 - BL, DL, ML Gen7,8,9
  - Superdome X
  - VMware, KVM

Storage

- HP Storage (Fibre Channel, iSCSI, FCoE)
  - 3PAR , P9000 , P6000, P4000, P2000
- 3rd Party Storage (only select models)
  - EMC, NetApp, IBM , HDS

Appliances

- ConvergedSystems for SAP HANA
  - CS500 Scale-up and Scale-out
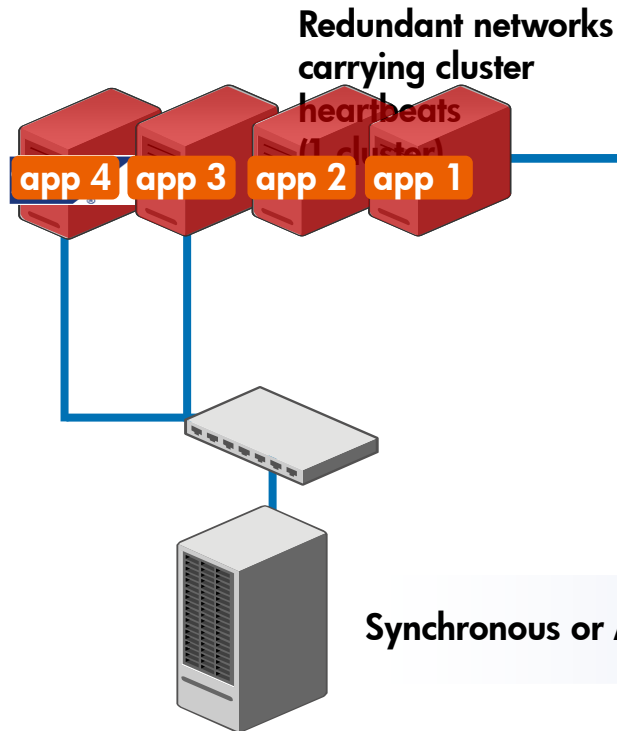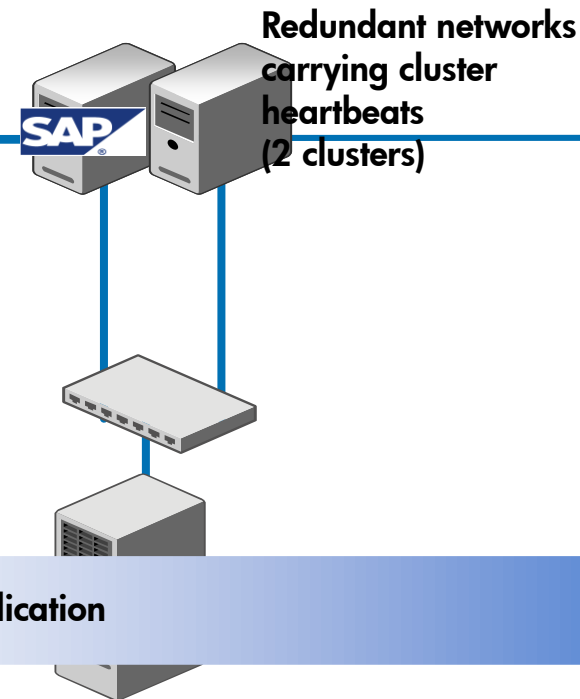 - CS900 Scale-up and Scale-out

HP Serviceguard Cluster

Quorum Server

Q

LAN

Heart-beat

HP Serviceguard

1

2

31

32

SAN

Application Package

Application Data in Shared Storage

HP Serviceguard Solutions in Action

- Across Availability Spectrum

Local Serviceguard Cluster

Metrocluster

Continentalclusters

Redundant networks carrying cluster heartbeats (1 cluster)

app 4 app 3 app 2 app 1

Redundant networks carrying cluster heartbeats (2 clusters)

SAP

app 4 app 3 app 2 app 1
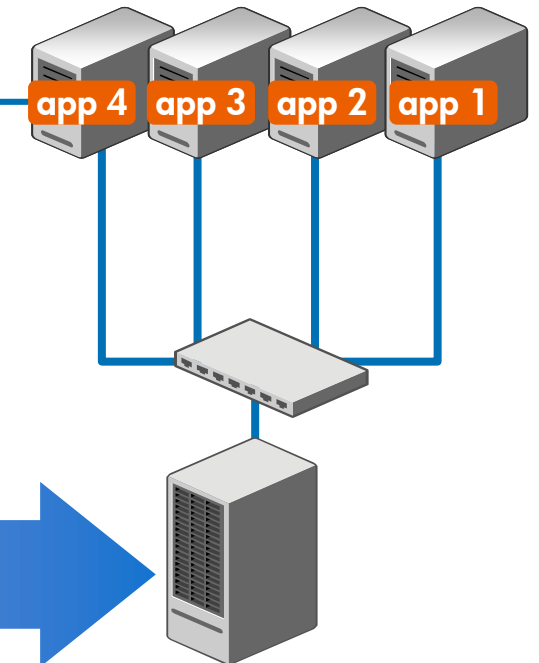
Synchronous or Asynchronous Replication

Leading global investment company selects Superdome X to run investment management front office solution


- Selected a whole new integrated software suite to rationalize their **investment management front office processes**
    - Up to 1000 connected users

- Application **database layer is mission-critical** and cost of downtime is extremely high

- Superdome X selected to **support the database** layer as it provides:
    - **Highest levels of reliability** than on standard x86 platforms, addressing the key requirement of solution availability
    - Better **Total Cost of Ownership** than competition
    - **Lower operating costs** by eliminating the need for proprietary skilled resources
    - **Flexibility** and ability to grow with the business by adding blades
    - **Scalability** for the clustered database based on isolated **HP nPars**

Total Cost of Ownership (TCO)
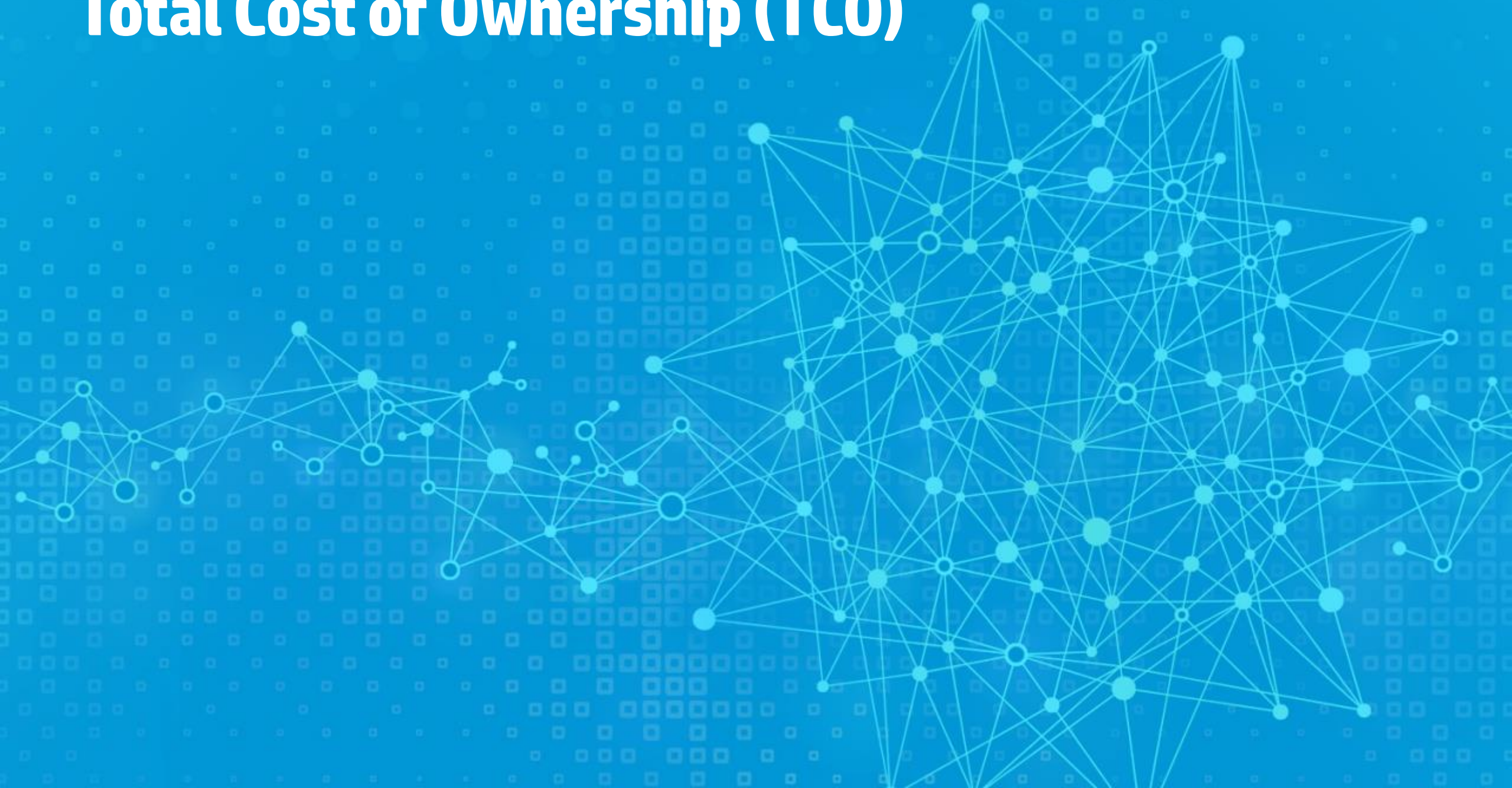
Industry-standard efficiency and breakthrough scalability
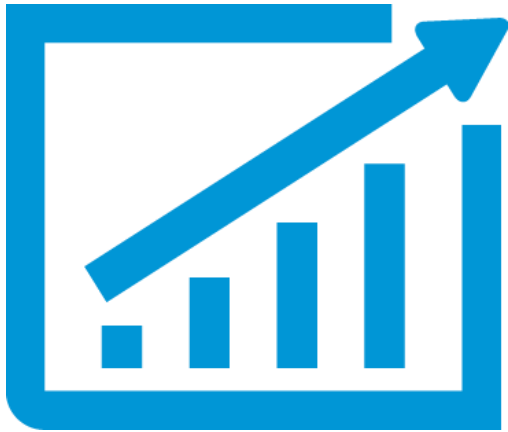
1-8 scalable blades
12-240 core count

32%
lower TCO than
competitive UNIX

Redefine the economics of your
mission-critical environment
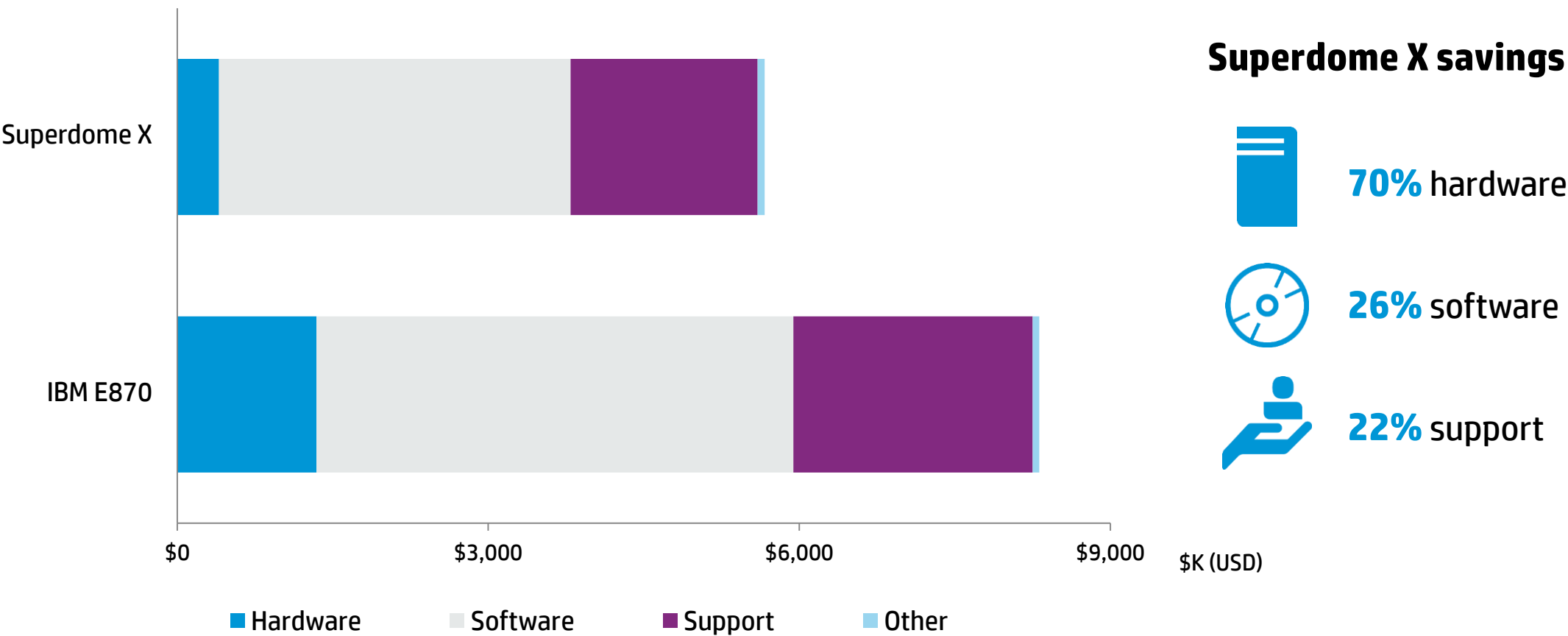
12TB memory

Address all your traditional and
in-memory database needs

2-16 sockets

Scale-up your large workloads to
new heights

32% lower TCO than IBM Power 8

HP Integrity Superdome X versus IBM E870 (3-year TCO model)

Superdome X savings

70% hardware

26% software

22% support

$0 $3,000 $6,000 $9,000 $K (USD)

Superdome X

IBM E870

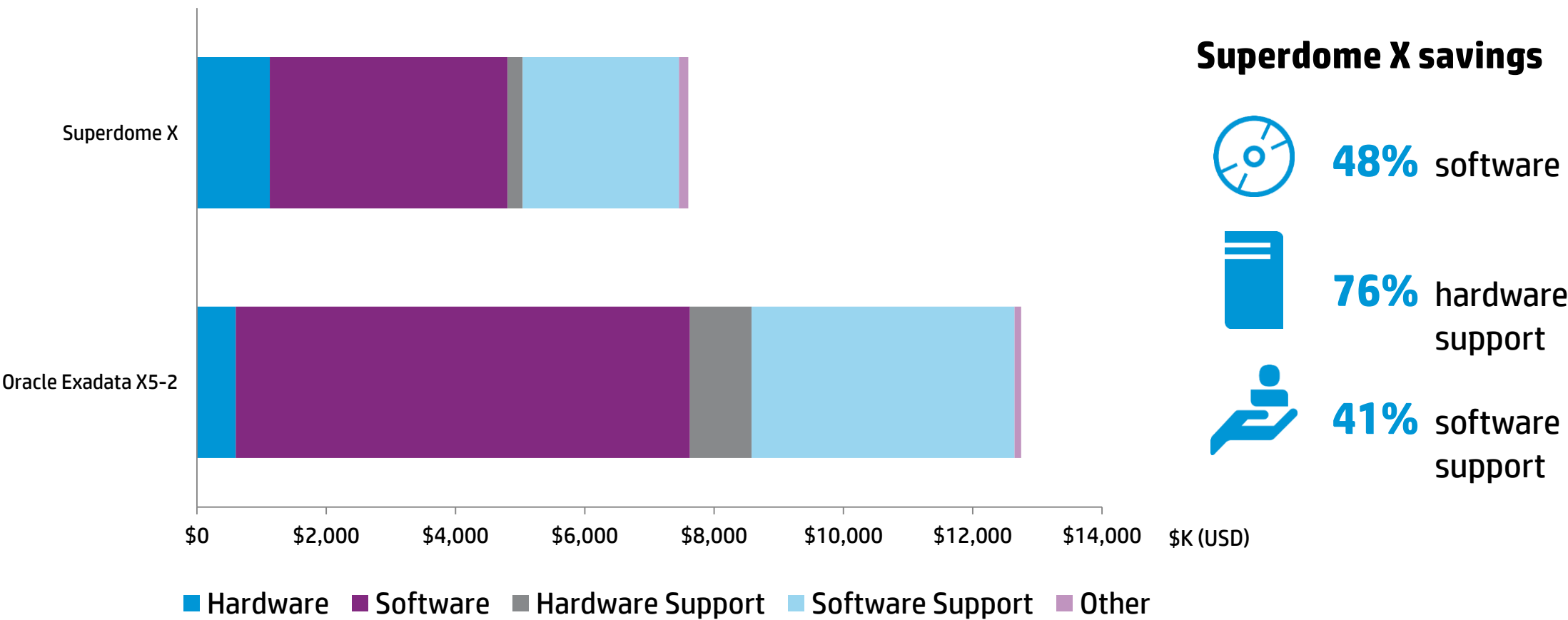■ Hardware   ■ Software   ■ Support   ■ Other

Compares an 8-socket Superdome X with 2x 4-socket partitions running SLES and an active/active Oracle RAC cluster with an IBM E870 with 2x 4-socket partitions running AIX and an active/active Oracle RAC cluster
Source: Based on HP results using publicly available competitive data, November 2014

40% lower TCO than Oracle Exadata

HP Integrity Superdome X versus Oracle Exadata X5-2 Half Rack (3-year TCO model)

Superdome X savings

48% software

76% hardware support

41% software support

Hardware Software Hardware Support Software Support Other

Compares an 8-socket Superdome X server and HP 3PAR StoreServ 7440c running RHEL and Serviceguard for Linux versus an Oracle Exadata X5-2 Half Rack running Exadata software and Oracle RAC.
Source: Based on HP internal analysis results using publicly available competitive data, April 2015

Deploy with confidence with proven services and a sustainable roadmap
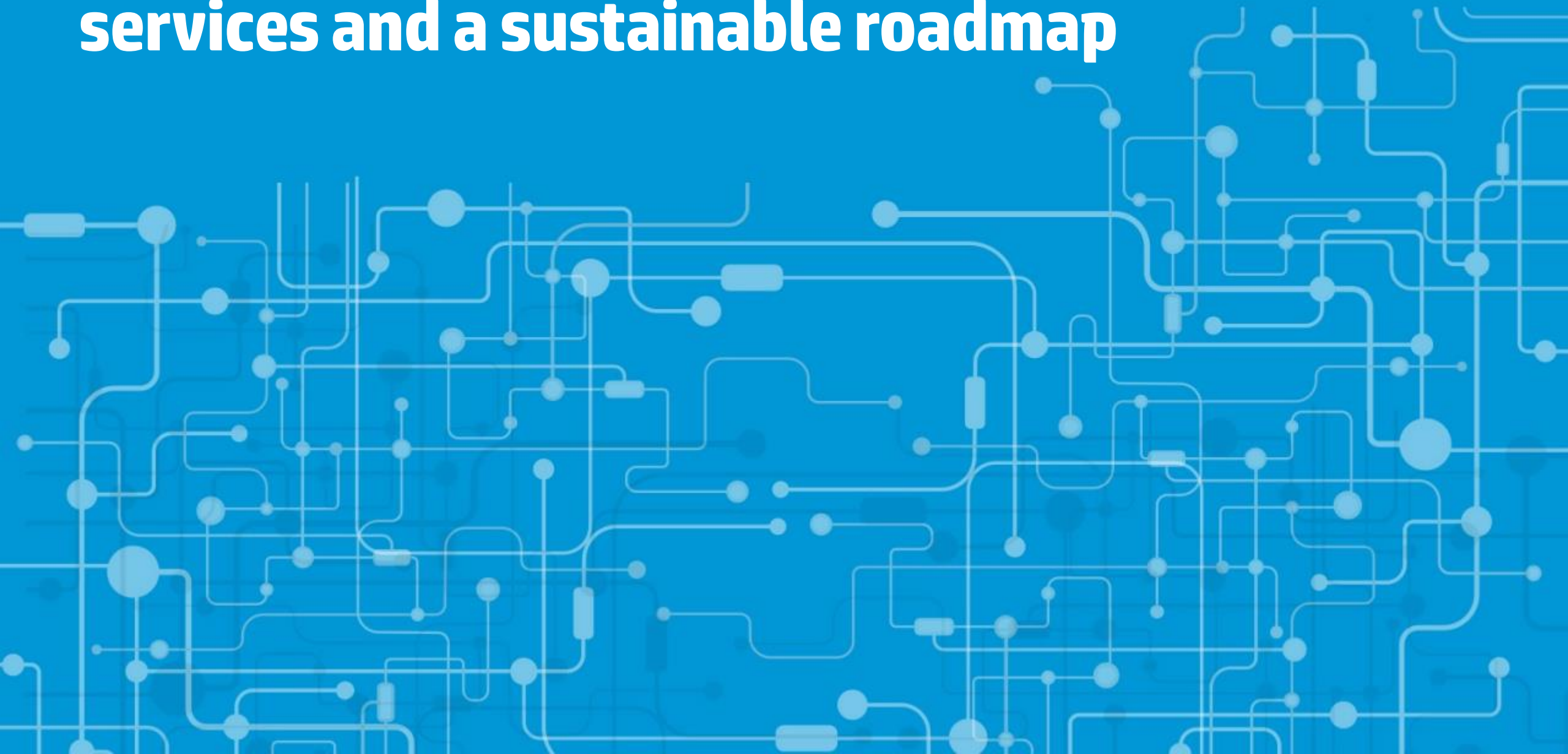
The business case for scale-up versus scale-out

More efficiencies and lower costs for SAP®, Oracle®, Microsoft® SQL Server and custom applications

**Scale-out to scale-up workload consolidation
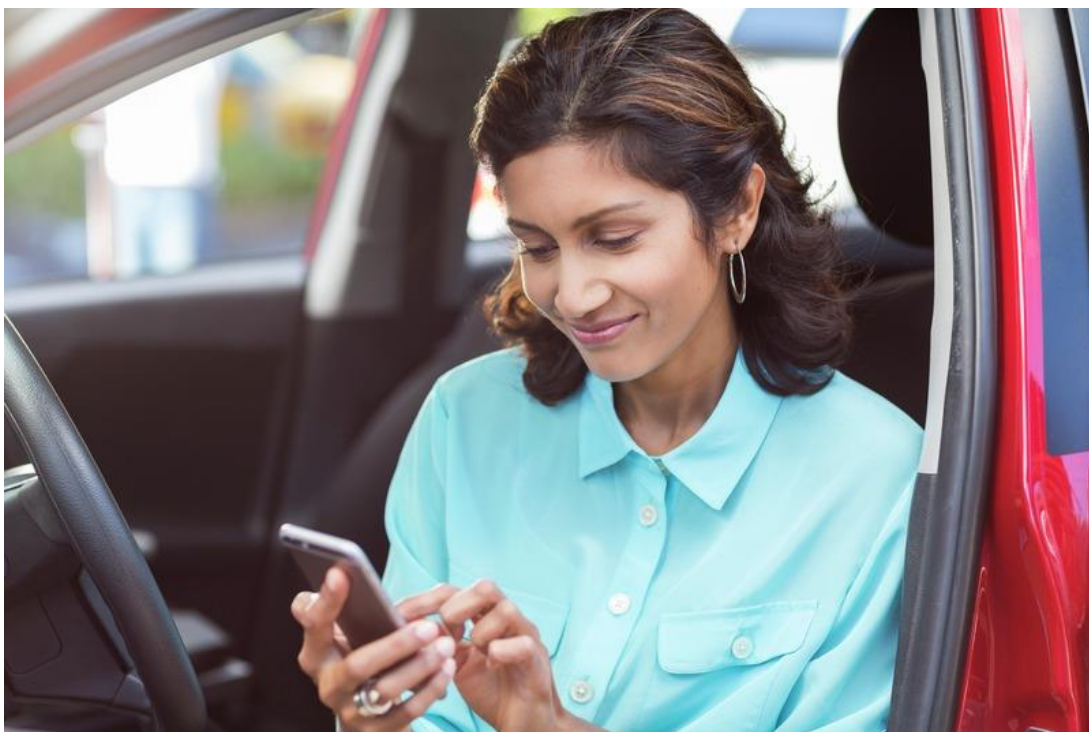for more efficient management and IT simplification**
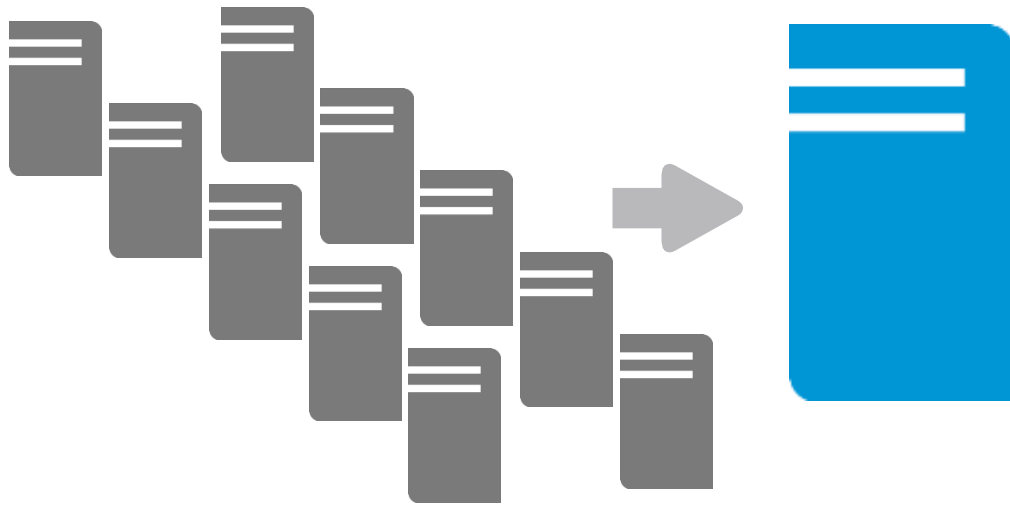
21% lower networking costs

37% reduction in licensing fees

2x better server utilization

European Service Provider selects Superdome X to manage business critical platforms

Focus on mission-critical reliability and cost efficiencies

Objectives

- Support customer growth
- Improve application performance
- Decrease Time To Market
- Reduce Capex and Opex

Approach

- Migrate legacy Unix servers to Superdome X
- Add Superdome 2 for stability during the migration process

Expected outcomes

- **More performance** to support business growth
- **Stable environment**
- **Lower TCO**

# Cerner chooses Superdome X to deliver hosted services

Cerner

- Powering core database for healthcare applications

- Replacing both x86 and older UNIX environments with Superdome X, as they standardize on x86 and RHEL

- Growing client base requires higher levels of infrastructure scalability, over and above what current x86 solution could offer

- With Superdome X, they now have an x86 server powerful enough for their largest environments

"As a global supplier of health information technologies, Cerner continues to innovate to meet our clients' needs. We look to HP as a partner to provide compute power in support of our innovation. The HP Integrity Superdome X provides the scalability to support our largest clients, the performance to deliver the results our clients have come to expect, and the availability that health care demands."
Kent Scheuler, SVP, Managed Service, Cerner

Deploy with confidence with proven services and a sustainable roadmap
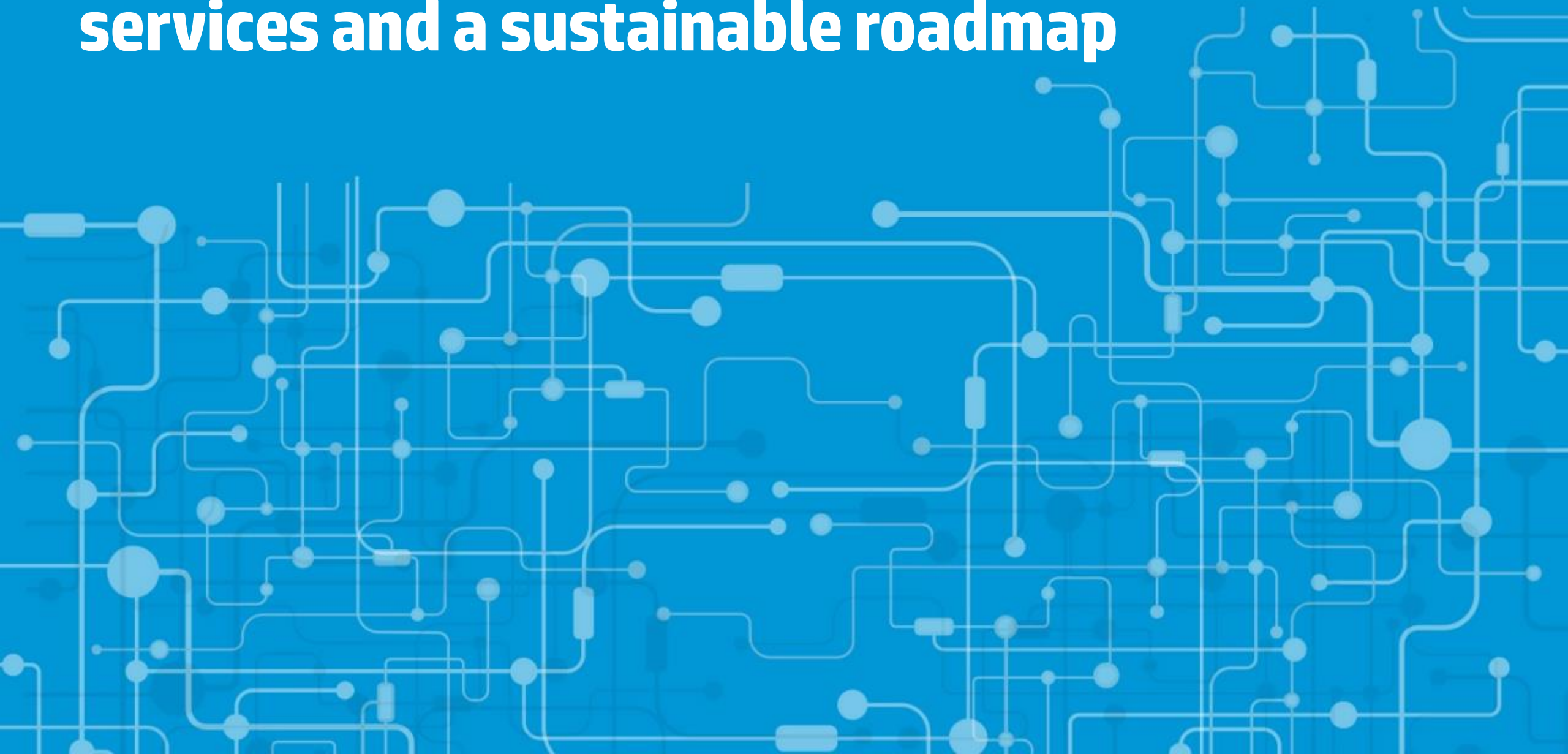
Optimize your results with HP Technology Services for Superdome X

Services for the most demanding enterprise x86 solutions

Ensure the right compute for the right workload

- Platform Migration Strategy
- Advisory Services
- Workload Advisory Services

Accelerate time of IT service to the business

- HP Migration Services
- HP Implementation Services
- HP Education Services

Optimize system utilization - increase agility and flexibility

- System partitioning
- Virtualization services

Prevent problems - Improve stability, boost performance

- Proactive Care Services
- Datacenter Care

Advise

Transform & Integrate

Flex

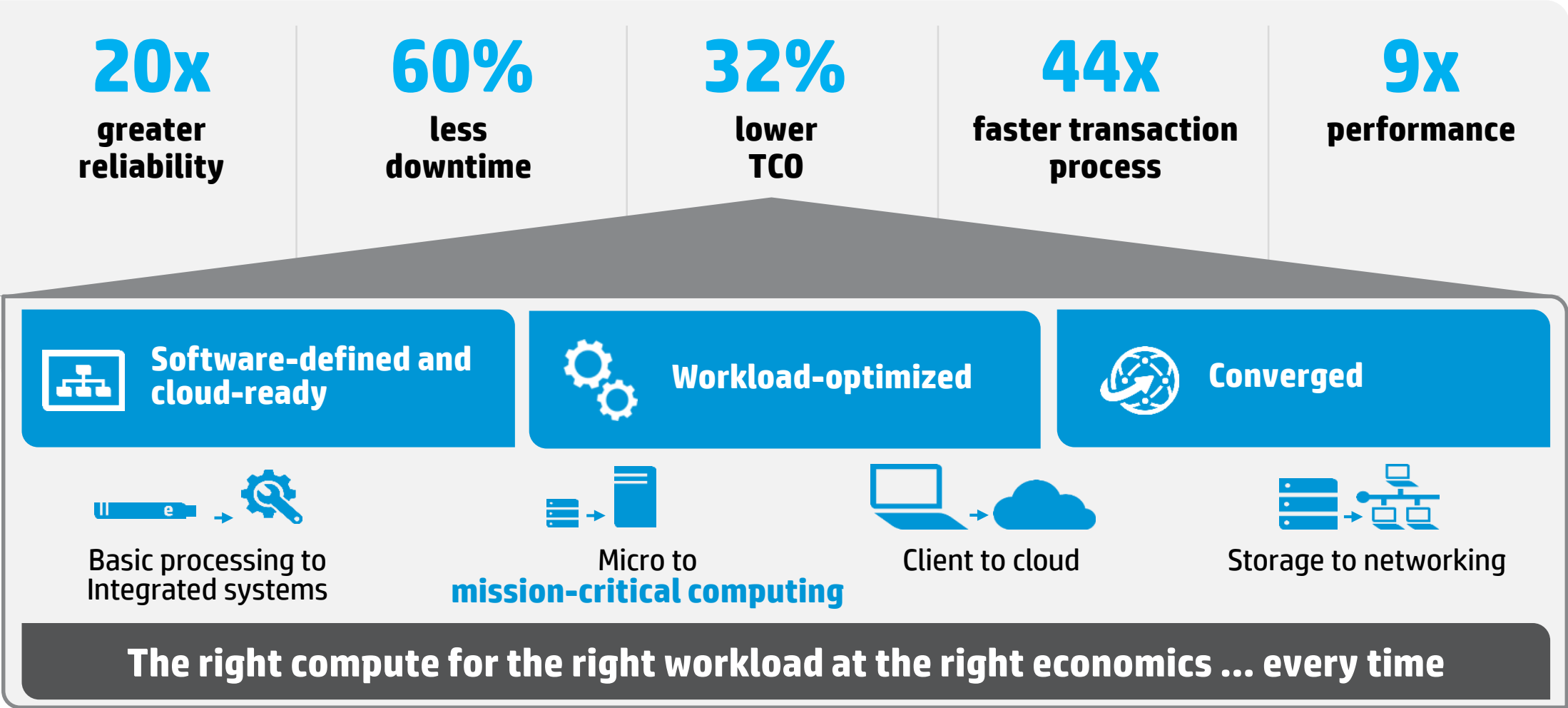Support

Superdome X Roadmap

Current

- Intel Xeon processor E7 v2 with 12-240 cores per system
- Operating Environment support with
  - RHEL 6.5, 6.6, 7.0
  - SLES 11 SP3
- Memory: DDR3 16 GB and 32 GB DIMMs
- 10GigE and 16 Gb FC
- **Windows, SQL Server, VMware** support

Future

- **Next Gen** Xeon processor support
- **Low core** count processor options
- **Memory:** DDR4 16 GB and 32 GB DIMMs
- **Infiniband and FCoE** support
- Continued support for **latest versions** of RHEL, SLES, Microsoft Windows Server and VMware vSphere

Think what compute can do for your business

20x	60%	32%	44x	9x
greater reliability	less downtime	lower TCO	faster transaction process	performance

Software-defined and cloud-ready

Workload-optimized

Converged

Basic processing to Integrated systems

Micro to **mission-critical computing**

Client to cloud

Storage to networking

The right compute for the right workload at the right economics ... every time

Transform your mission-critical environment

Superdome X—for faster, better business results

Drive business growth
with **breakthrough** performance

Increase competitive differentiation
and **reduce** your **business risk**

Redefine mission-critical compute economics
with **industry-standard** efficiencies

Thank you