Get the Best of Your Database
Red Hat and HPE combined

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On your journey to SAP HANA?

What is your challenge?

Migrating your core business solutions from Unix?

Unable to meet your SLAs for SQL Server workloads?

Think you can’t virtualize mission-critical applications?

Dreaming of mixing OLTP and OLAP in the same machine?

Need more uptime?

Modernizing your SAP system?

Worried about Oracle licensing costs?

What is your challenge?

Need more uptime?
Today's Topics

- Red Hat / HPE Alliance Overview
- Economic Database Scaling
- Advanced Virtualization Flexibility (Demo)
- SAP HANA on Red Hat / HPE
- Selected Tuning Tools
- Take Away
Red Hat / HPE Alliance Overview
HPE and Red Hat – Proven partnership for success

Superior results
- Most servers and storage certified
- Leading benchmark results

Certification, integration, and support

Market development

Superior experience
- More than 4,000 Linux Service Professionals x86 server Linux market share leader

Our alliance

16 years

Open source and open standards innovation

Our customers

Superior alignment
- Partnering to deliver transformational solutions for the New Style of Business

Strategic development

Superior commitment
- More customers run RHEL on HPE servers than any other platform

Strategic development
Example Linux kernel development to support MC x86
Done in community partnership by Hewlett Packard Enterprise and Red Hat developers

HPE and Red Hat actively collaborate, with more than 125 patches submitted to advance Linux for mission-critical x86 implementations.

- Identify areas to improve and problems to fix
- If no upstream patches already exist:
  - Develop and validate fix
  - Submit the patches upstream for acceptance
- Back-port patches 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.

- **Improve scalability and performance** – Very large workload Intel Xeon® ProLiant support
- **Improve security and reliability** – Secure boot support
- **Improve reliability** – PCI LER/AER enabling hot plug for memory and CPU
- **Improve virtualization scalability and performance** – KVM hypervisor becomes NUMA-aware to improve performance to near-bare-metal speed
Economic Database Scaling
Do you want your tpcc-like workload to scale like this?
Comparison: accepted ratio is 1.6
Scale on your terms: **Start small, grow seamlessly when needed**

- **1-8 blades**
- **2-16 sockets**
- **8-384 core count**
- **24 TB memory**
Superdome X at a glance

Front view
- BL920s Gen8 or Gen9 server blade (Max: 8)
- Insight Display
- 12 x c-Class 2450W power supplies
- DVD module
- Air inlet plenum for blades and XFMs

Rear view
- Air exhaust plenum for power supplies
- 4 x XBAR fabric modules (XFMs)
- 2 x Global Partition Service Modules (GPSPMs)
- 8 x interconnect modules
- 2 x SD2 OA modules
- Air exhaust plenum for power supplies
- AC input module (3-phase or single-phase)
- Active cool fans (15:3 rows of 5)

Height: 18U
# The unique value of HPE nPars

Hard partitions add flexibility and cost efficiencies

<table>
<thead>
<tr>
<th>Lower your TCO</th>
<th>Maximize resource utilization</th>
<th>Minimize downtime</th>
<th>Protect your data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optimize software costs by using HPE nPars</td>
<td>Create different development, test, and production environments within a single enclosure</td>
<td>Take one partition offline, perform maintenance and/or reconfiguration, while other partitions continue to run undisturbed 20x greater reliability</td>
<td>Electronic isolation provides a high degree of security between partitions</td>
</tr>
</tbody>
</table>

**HPE BladeSystem Superdome Enclosure**

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

### HammerDB performance in tpm

<table>
<thead>
<tr>
<th>Configuration</th>
<th>4 BL920 120 cores</th>
<th>2 BL920 60 cores</th>
</tr>
</thead>
<tbody>
<tr>
<td>TPM</td>
<td>7,000,507</td>
<td>3,931,072</td>
</tr>
</tbody>
</table>

**HP Superdome X**
- nPartition 1 with 4 BL920
- 6 TB RAM
- 8 sockets @ 2.8hz – 120 cores

**Red Hat EL 6.5**
- Hammerdb v2.16

**Red Hat EL 7.0**
- Oracle EE 12.1.0.2
- ASM
- 4 Oracle instances

**4 MSA 2040 FC**
- 64 SSD disks

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**Hewlett Packard Enterprise**
AutoNUMA with SPECjbb workload

This graph comes from a Red Hat presentation delivered during the RH Summit 2014.
NUMA tuning with Oracle database workload
No NUMA vs. Auto-NUMA vs. Auto-NUMA + HPE Optimization

Numa characterization
Tuned-adm
To be definitely considered

[root@dh20 ~]# tuned-adm list
Available profiles:
- balanced
- desktop
- latency-performance
- network-latency
- network-throughput
- powersave
- sap
- throughput-performance
- throughput-performance-no-thp
- virtual-guest
- virtual-host
Current active profile: throughput-performance-no-thp

These 3 profiles were tested throughput-performance-no-thp shows slightly higher performances

# tuned-adm profile throughput-performance-no-thp
Database Consolidation: Customer case
Two (2) databases per core – 80 DBs – 8,000 concurrent users in a partition

Initial result with configuration define by the customer team:
280,000 tpm

HPE Superdome X test with similar configuration:
900,000 tpm

HPE top performance measured with up to 20 PDBs
1,600,000 tpm (at peak)
**Superdome X – In Memory workload**

**Initial run:**
101 transactions/hour with 4 PDBs

**In Memory enablement:**
956 transactions/hour

<table>
<thead>
<tr>
<th>Total completed transactions</th>
<th>28</th>
<th>20</th>
<th>20</th>
<th>33</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average transactions per second</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>Maximum transaction rate</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Total Failed Transactions</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Average response time</td>
<td>1795524.43</td>
<td>1974997.00</td>
<td>1583030.15</td>
<td>1341288.30</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>787798.09</td>
<td>1183070.45</td>
<td>1533271.43</td>
<td>832673.72</td>
</tr>
<tr>
<td>Minimum response time</td>
<td>58925</td>
<td>2010</td>
<td>48706</td>
<td>34740</td>
</tr>
<tr>
<td>Maximum response time</td>
<td>2585195</td>
<td>2585100</td>
<td>3707186</td>
<td>2932297</td>
</tr>
<tr>
<td>Geometric mean</td>
<td>1445948.09</td>
<td>1188679.38</td>
<td>1058285.54</td>
<td>1022175.56</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total completed transactions</th>
<th>234</th>
<th>240</th>
<th>233</th>
<th>249</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average transactions per second</td>
<td>0.06</td>
<td>0.06</td>
<td>0.06</td>
<td>0.06</td>
</tr>
<tr>
<td>Maximum transaction rate</td>
<td>11</td>
<td>11</td>
<td>9</td>
<td>11</td>
</tr>
<tr>
<td>Total Failed Transactions</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Average response time</td>
<td>302812.40</td>
<td>303198.86</td>
<td>311310.99</td>
<td>292431.06</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>272905.61</td>
<td>223966.35</td>
<td>347280.94</td>
<td>28021.86</td>
</tr>
<tr>
<td>Minimum response time</td>
<td>32445</td>
<td>33497</td>
<td>34227</td>
<td>9970</td>
</tr>
<tr>
<td>Maximum response time</td>
<td>1342491</td>
<td>1405383</td>
<td>2347809</td>
<td>1814952</td>
</tr>
<tr>
<td>Geometric mean</td>
<td>210596.92</td>
<td>239080.39</td>
<td>217370.82</td>
<td>215612.46</td>
</tr>
</tbody>
</table>

**Oracle In Memory setup**
- `inmemory_max_populate_servers=120`
- `inmemory_size=109951627776`
- `open_cursors=4500`
- `parallel_degree_policy='AUTO'`
- `parallel_execution_message_size=32768`
- `parallel_max_servers=480`
- `parallel_min_servers=160`
- `pga_aggregate_limit=483183820800`
- `pga_aggregate_target=429496729600`
- `resource_manager_plan=''`
- `sga_max_size=1717986918400`
- `sga_target=1610612736000`
- `use_large_pages='ONLY'`

**Oracle In Memory usage**
- The 4 SH schemas were loaded into the columnar format.
- The compression ratio was 4 on average
- The tables were loaded with « query low » option (means low compression)
- The table were pinned into the memory with a « critical » status. It means they were loaded at the boot time
- The time to upload the 4 entire schema (2TB on disk) into memory was 20 to 25 minutes.
- During the test, the CPU load was around 95%
- During the test, the IO usage was low.
Advanced Virtualization Flexibility
Solution Architecture

HPE Superdome X

2xBL920s hard partition
60 cores – 120 threads
1TB of RAM

RHEV 3.6.1.3

Virtual Machine 1
Guest RHEL 7.2
80 vCPUs
512GB RAM
Oracle Database 12.1.0.2
In Memory option enabled
Average CPU usage: 85%

2xBL920s hard partition
60 cores – 120 threads
1TB of RAM

RHEV 3.6.1.3

Virtual Machine 2
Guest RHEL 7.2
4 vCPUs
1GB RAM
Swingbench 2.5
70 users – DSS workload
Live-Migrating a Memory-intensive Workload

NPar 1

NPar 2

VM1
80 vCPUs / 512GB vRAM
Oracle Database 12.1.0.2
Average CPU usage: 85%

VM2
4 vCPUs
Swingbench 2.5
70 users – DSS workload

HPE Superdome X

memory run-length encoding / auto-convergence
Demonstration
SAP HANA on Red Hat / HPE
Red Hat: Key to SAP HANA Success

“The #1 requested thing that we got was not a feature for the product, it was support for Red Hat” (in regards to SAP HANA)

“Our largest financial customers came to us and said that we are not going to buy anything from you unless you support Red Hat.”

"The Red Hat platform is the fastest growing platform for our SAP core product SAP HANA on the market today."

Steve Lucas
President, Platform Solutions SAP
2015 Red Hat Summit Keynote

https://www.youtube.com/watch?v=_UiKdgasgQ0
Portfolio of real-time data management systems
Optimized appliances for SAP HANA

HPE ConvergedSystem 500

- **Innovative:** Built on the next generation Intel® Xeon® E7 Haswell Processor
- **Fastest Performance:** #1 SAP BW-EML benchmark results
- **Right sized for you:** Start as small as 128GB, and grow up to 24TB
- **Choice:** Over 1,000+ scale-up and scale-out configuration possibilities

HPE ConvergedSystem 900

- **Bigger business applications:** Large, demanding, complex SAP landscapes; Application aggregation and consolidation
- **Right sized for you:** Highly flexible scale-up systems for SoH and S/4HANA from 1 TB to 12 TB
- **Unmatched Scalability:** Massive scale-out system for BWoH from 2 TB to 144 TB
- **Reliability:** Mission-critical high availability and data protection

1 Larger scale-out systems may be available at HPE and SAP’s discretion
2 Certified up to 32 TB; customers may scale out to 144 TB with a custom SOW
Selected Tuning Tools
Significant OLTP performance gains with HPE-ATX
– Database performance gains with HPE Integrity Superdome X Gen9

HPE Application Tuner Express (ATX): Launches applications on large core count systems in an efficient way, delivering significant performance improvements

Cut your per-core licensing costs almost in half!

Up to 13% improvement on 4P with HPE-ATX!

<table>
<thead>
<tr>
<th></th>
<th>Without ATX</th>
<th>With ATX</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4.058</td>
<td>4.507</td>
</tr>
</tbody>
</table>

1.77x scaling with HPE-ATX!

<table>
<thead>
<tr>
<th></th>
<th>Without ATX</th>
<th>With ATX</th>
</tr>
</thead>
<tbody>
<tr>
<td>8P</td>
<td>6.391</td>
<td>7.985</td>
</tr>
</tbody>
</table>

Up to 24% improvement on 8P with HPE-ATX!

<table>
<thead>
<tr>
<th></th>
<th>Without ATX</th>
<th>With ATX</th>
</tr>
</thead>
<tbody>
<tr>
<td>8P</td>
<td>8.929</td>
<td></td>
</tr>
</tbody>
</table>

Up to 58% improvement on 16P with HPE-ATX!

<table>
<thead>
<tr>
<th></th>
<th>Without ATX</th>
<th>With ATX</th>
</tr>
</thead>
<tbody>
<tr>
<td>16P</td>
<td>14.140</td>
<td></td>
</tr>
</tbody>
</table>

Hammer DB OLTP multi-tenant workload

HPE Superdome X using BL920s Gen9 blades with Intel® Xeon® E7-8890 v3 processors

Intel and Xeon are trademarks of Intel Corporation in the U.S. and other countries. HPE internal testing. Performance results with HPE-ATX (patent pending) on the Superdome X with Gen9 were achieved with one tenant totaling 144 users (4P), two tenants totaling 288 users (8P) and four tenants totaling 576 users (16P) for a 1-to-1 mapping of users to logical CPUs. Configurations that are over-subscribed may show less performance gain. Results as of April 6, 2016.
System Resource Orchestrator (SRO)

SRO is a workload manager for Linux/Windows for scale-up environments orchestrating memory, CPU, storage and networking, guaranteeing the right amount of resources at the right time for your business critical applications.

**Orchestration of**
- CPU
- Memory
- Networking
- Storage

**OS supported**
- RHEL 6.5
- RHEL 6.6
- RHEL 7.x
- SUSE 11
- Windows

**Hardware Supported**
- Superdome X
- Proliant (SL, DL, BL, ML)

**Integrates with**
- One View
- Service Guard
- Workload Insight
- Docker/Docker Orchestration Tools

**Policies**
- Fixed
- Utilization
- Own-Borrow
- Conditional
- Custom

**BENEFITS**
- Optimal utilization of System Resources
- Optimized workload consolidation
- Application agnostic
- Easy user interface for workload management
- Lower TCO with OS License and Support costs reduction
- Reduced administration costs
- Better performance with same resources

*Text: Would be available in future versions*
Take Away
Proof Point #1: **Statens Innkrevingssentral modernizes collections infrastructure**

- **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**
Proof Point #2: Cerner chooses Superdome X to deliver hosted services

- 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 HPE as a partner to provide compute power in support of our innovation. The HPE 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
More information is available

– Operating Environments
  – HPE & Red Hat Alliance
  – HPE Operating System Support Matrices
  – Red Hat Certified Hardware
– Superdome X external portals
  – www.hpe.com/servers/superdomex
  – www.hpe.com/info/superdomex
– Solutions
  – Application Tuner eXpress
  – System Resource Orchestrator
  – Rapid Setting For Oracle
Thank you